SCIENCE ABSTRACTS.

Section A.—PHYSICS.

NOVEMBER 1907.

GENERAL PHYSICS.

1785. *Resonance Effects produced in Hydraulic Rams.* **de Sparre.** (Houille Blanche, 6. pp. 203–207, Sept., 1907.)—It has been shown [see Abstract No. 2084 (1905)] that the relative effect of water-hammer shocks is much less sensible for high falls than for low falls with large delivery. From consideration, however, of a simple theoretical case it appears that this is not true unless resonance effects are prevented, since these may cause a hammer effect with pressure even greater than that due to the head, which in the case of high heads might be serious. R. E. B.

1786. *Elastic Constants of Aragonite.* **W. Voigt.** (Gesell. Wiss. Göttingen, Nachr., Math.-Phys. Klasse, 2. pp. 145–159, 1907. Ann. d. Physik, 24. 2. pp. 290–304, Nov. 12, 1907.)—The author's measurements by bending and drilling methods give the following values for the elastic moduli of aragonite :—

S_{11}...... $6{\cdot}84 \times 10^{-8}$ S_{22}...... $12{\cdot}89 \times 10^{-8}$ S_{33}...... $11{\cdot}97 \times 10^{-8}$
S_{44}...... $28{\cdot}82 \times 10^{-8}$ S_{55}...... $88{\cdot}24 \times 10^{-8}$ S_{66}...... $22{\cdot}95 \times 10^{-8}$
S_{23}...... $-2{\cdot}88 \times 10^{-8}$ S_{31}...... $+0{\cdot}42 \times 10^{-8}$ S_{12}...... $-2{\cdot}98 \times 10^{-8}$

The other constants are derived, and the principal sections of the elastic surfaces given. If the X, Y, Z axes of Iceland spar be regarded as corresponding respectively to the X, Z, Y axes of aragonite, then all the moduli of spar are greater, and all the other constants smaller, than those of aragonite. The constants for Iceland spar were given in a previous paper [ibid. 19., 1889]. This is regarded as proof that in the transformation from one form to the other the axes do not correspond to one another physically. F. R.

1787. *Theory of Elasticity.* **G. Ercolini.** (N. Cimento, 13. pp. 401–417, May, 1907.)—Describes a model illustrating the various elements entering into the behaviour of an elastic solid. It consists of a tube divided into three compartments by suitable diaphragms. The central compartment is filled with a viscous liquid. Two pistons, of cross-section smaller than the interior of the tube, move in the viscous liquid, the piston rods being connected with the outside by spiral springs. Another set of spiral springs surround the piston rods within the liquid, and the number of turns of these brought into action can be varied by a special contrivance. By means of this model the author illustrates instantaneous deformation, hysteresis, subsequent deformation, and elastic fatigue. The phenomenon known as "accommodation" can be shown by repeating a set of reversals many times. Residual and permanent deformation are also illustrated. The author hopes to investigate the phenomena presented by indiarubber and by the eutectic alloy of lead and tin by this means. In the present unsatisfactory state of elastic theory the model, or a modification of it, must be a useful guide. E. E. F.

1788. *Stresses in Metals due to Cooling.* **E. Heyn.** (Stahl u. Eisen, 27. pp. 1309–1315, Sept. 11, and pp. 1347–1353, Sept. 18, 1907.)—The author systemically considers the occurrence of internal stresses in castings or forgings, through differences in the rates of cooling of different parts of the piece. The method employed is that of the discussion of the behaviour of two pieces of metal clamped together, which are at different temperatures; and besides the case of perfect elasticity, two others of importance arise, viz., when the elastic limit is exceeded, and when the plastic limit is exceeded. The "plastic limit" is here the temperature above which the material flows plastically under stress. In order to study the occurrence of internal stresses in cooling, a knowledge of the plastic limit may be obtained by heating two pieces of the metal clamped together in such a manner that one is in tension, the other in compression. The temperature at which the stresses disappear is the plastic limit. The disappearance of stress is to be detected by measurements made between marks on the bars. Examples of castings which have cracked in cooling are described. F. R.

1789. *Design of Reinforced Concrete Beams.* (Eng. News, 58. pp. 28–30, July 11, 1907.)—Gives curves for the design, which are founded on formulæ given by the usual bending theory. These are—

$$r = np[1 + \sqrt{(1 + 200/np)}]/100\ ; \quad T = nC/r\ ; \quad m/d = 1 - r/3(1 + r)\ ;$$
$$M = FTm = pTmd^2/100d\ ;$$

where n is the ratio of the moduli of elasticity for steel and concrete, the values used for the diagrams being 11, 13, and 15; d is the depth of beam from extreme compression side to centre of reinforcement; x is distance of neutral axis from extreme compression side; $r = x/(d - x)$; $m = d - x/3$; F = area of steel per inch width of beam; $p = 100F/d$; C = max. compressive stress in concrete (taken as 700 lbs. per sq. in.); T = max. tensile stress in steel (taken as 17,000 lbs. per sq. in.); M is the bending moment per inch width of beam. The adhesion between concrete and steel is taken as 64 lbs. per sq. in. Examples of the uses of the diagrams are given. A diagram for the same purpose by E. J. Coppage is also given, in which the stress in the concrete is one of the co-ordinates, this arrangement being sometimes more convenient. F. R.

1790. *Adhesion of Steel in Reinforced Concrete Beams.* **L. J. Johnson.** (Eng. News, 58. pp. 169–170, Aug. 15, 1907. From the Journ. of the Assoc.

of Engineering Societies, June, 1907.)—In order to attain a high value of vertical shear stress, and hence, as shown by an approximate method of analysis, of shear between steel and concrete in the usual arrangement of a reinforcing bar in a concrete beam, the beams were tested under two loads arranged symmetrically only a short distance from their ends. The average adhesion stresses developed in the case of 1 : 2½ : 5 mixture were 774 lbs. per sq. in., varying according to type of reinforcement. (The reinforcements used were plain round, Johnson corrugated, cold-twisted square, either straight or turned up to a hook form at each end, or bent round an anchor rod.) With 1 : 2 : 2½ mixture, the average adhesion was 1,094 lbs. per sq. in. It is pointed out that the bending of the beams was in the present case sufficient to affect the slipping materially; that is often the case in practice, hence adhesion figures deduced from tests in which a bar is pulled from a block of concrete in which it is embedded, are probably in general lower than under actual working conditions. The values given by the present experiments may, however, be too high to be used in design, as the method of loading is somewhat exceptional. F. R.

1791. *Effect of Steam Curing on Crushing Strength of Concrete.* **R. J. Wig** and **R. F. Havlik.** (Eng. News, 58. pp. 249–250, Sept. 5, 1907. Thesis presented to the Lewis Institute, Chicago.)—The steam treatment consisted of immersion of the blocks, 24 hours after moulding, in a steam bath generally under about 2½ lbs. per sq. in. pressure. The mixture was 1 : 3 : 4½. It is concluded that steam-treated concrete receives its primary set sooner than if not treated. If the steam treatment be not followed by any further treatment, the strength acquired in the course of time by the concrete is not so great as that of concrete allowed to set primarily in air and then kept moist. With less than 24 hours' steam treatment the treated concrete is the stronger during the first week. If, however, steam-treated concrete be subsequently kept moist, its strength both primarily and ultimately is greater than that of corresponding non-treated material. The strength of steam-treated concrete increases with the duration of the steam treatment. Results are also given for different pressures and with additions of CO_2 to the steam, but these are too limited to allow of general deductions. F. R.

1792. *Air-resistance.* **Jouguet.** (Comptes Rendus, 145. pp. 500–502, Sept. 9, 1907.)—In this paper the author applies the theory of similitude to the study of air resistance. If the velocity of the moving body A is feeble, it results from a theorem of Helmholtz that the air moves sensibly as if it were incompressible, very viscous, and a very good conductor of heat. The resistance which it exerts to the motion of A ought therefore to be analogous to that of water. It is doubtless due to the viscosity of the fluid, and hence Poncelet and Saint-Venant's theory can be applied. The author has previously shown under what conditions the law of similitude can be applied to this theory, and that it leads to a proportionality approaching the square of the velocity. This has been confirmed by experiment, notably by Renard's researches. If the velocity of A is very great, the theorem of Helmholtz shows that the air behaves like a feebly conducting, feebly viscous but very compressible fluid. When the velocity of A is greater than that of sound, the resistance it experiences is probably then due to the formation of a compression wave which precedes it. From this the author deduces mathematically that at very great velocities the resistance of the air is proportional to the square of the velocity. A. W.

1793. *Displacement Resistance of Solids in Fluids.* **K. Uller.** (Ann. d. Physik, 23. 1. pp. 179–196, May 28, 1907. Phys. Inst. d. Univ., Giessen, March 22, 1907.)—The author distinguishes resistance to pure displacement from the "cohesion resistances" due to viscosity and skin resistance. The former varies as the square of the speed, the latter simply as the speed. He indicates new methods for discriminating between the applicability of these two laws, and for finding the limits of such applicability. He shows that, in general, a periodicity is only possible with a "linear" resistance, and not with a resistance obeying the square law. In the latter the decrement of periodic motion decreases as the amplitude decreases, whereas with a linear resistance the decrement is constant. The position of the reversal points depends upon the intensity of the driving force in case of a linear, but not in case of a quadratic resistance. If only the intensity of the force varies, the ratio of corresponding periods is independent of the resistance of the medium in the case of a quadruple resistance, but not otherwise. A rising balloon, a falling body, and a vessel driven through water obey the same law of resistance, only the numerical constants vary. E. E. F.

1794. *Gravity at Booth Wandel Island, Graham Land, during the Charcot Expedition.* **Matha.** (Comptes Rendus, 145. pp. 398–401, Aug. 12, 1907. Extract.)—The pendulum applied was the same which Bouquet de la Grye had used on Campbell Island, in Mexico, and Senegal. The oscillations, of amplitude of 1°, were determined by the method of coincidences, each of the 6 series of from 10 to 25 observations taking 8 hours. Similar determinations were made at Paris before and after the expedition, with the results: $t = 0{\cdot}960098$ and $t = 0{\cdot}9600905$ sec. Accepting the value of Defforges, $g = 981{\cdot}012$ cm. at Paris, the theoretical length of the pendulum would be $l = 91{\cdot}6218$ cm. In the Antarctic at Port Charcot, latitude 65° 08′ 45″ S. and longitude 66° 21′ 12″ W., t was found to be $0{\cdot}959890$ sec., and g hence $982{\cdot}489$ cm., while the formula of Defforges $g = 978{\cdot}106\,(1 + 0{\cdot}005243 \sin^2 \lambda)$ cm., would give a value lower by 0·116 cm. Other observations in relatively high southern latitudes have also given higher values for g than the formula, the excess being at Staten Island 0·086, Cape Horn 0·058, Deception Island 0·107 cm. The flattening near the pole may therefore be greater than Defforges assumed, or the interior strata may be denser. H. B.

1795. *Guilbert's Principles of Weather Forecasting.* **O. L. Fassig, G. Guilbert.** (Monthly Weather Rev. 35. pp. 210–211 and 211–212, May, 1907.)—During the Liége Exhibition of 1905 the Belgian Astronomical Soc. invited competition in weather forecasting. The first prize was awarded to G. Guilbert, of Caen, for a memoir dated Sept. 28, 1905. The first of these papers contains comments by Fassig and by Brunhes, the chairman of the jury, on the method, which has since been found to be superior to any other; the second is a translation by Fassig of Guilbert's memoir. Guilbert distinguishes winds of normal and of abnormal force. A wind of force 2 is normal to a gradient of 1 mm. per degree of 111 km., force 4 normal for 2 mm., force 6 normal for 3 mm., and force 8 normal for a gradient of 4 mm. Winds are often abnormal, either by excess (too strong for the gradient) or by deficiency (too weak), and the abnormality may be very pronounced. A depression can only subsist if the wind force is proportional to the gradient, when there will be equilibrium between the centrifugal force (gradient) and the centripetal force (wind force). With a wind abnormal by excess the pressure will rise, as a rule, proportionally to the excess; with a wind abnormal by deficiency the pressure will fall; with a normal wind the barometer will remain steady. A depression completely surrounded by excessive winds will fill up in 24 hours and less; a sharp depression, not marked by strong winds, may develop into a storm. The centre of the depression moves towards the regions of least resistance, where the winds are either abnormally weak, or where—which is more important—the winds are divergent with reference to the centre of the depression; the distances of these regions may be large. These are the regions in which the barometric changes will be maximum, not those in which the pressure is actually at a maximum or minimum. The air will flow in a direction which is at right angles to the wind which is abnormal by excess and to the right of it. If converging winds bring the air straight to the centre of the depression, along the gradient, the depression will be filled up; diverging winds will tend to produce a void which is a depression. The approach of an oceanic depression is announced by successions of clouds; on the Continent the depression can then be followed and forecasts be issued. H. B.

1796. *Temperature Observations at Vicksburg and in Low Ground near it.* **W. S. Belden.** (Monthly Weather Rev. 35. pp. 219–221, May, 1907.)—On clear nights the temperature is, as a rule, lower in lowlands and valleys than in adjacent uplands, and higher in towns than in the surrounding open country. The latter effect is due to the greater percentage of dust in the atmosphere above towns. To study these features the author arranged for two special weather stations in addition to the town station at Vicksburg, Miss. Station A lies in a narrow valley in the southern suburbs of Vicksburg, station B in the low-level lands north and west of the city, 64 ft. below A. The lowest temperatures were observed at A, which in 4 months was on 15 mornings 10° F. colder than the town station. H. B.

1797. *Relation of the Movements of the High Clouds to Cyclones in the West Indies.* **J. T. Quin.** (Monthly Weather Rev. 35. pp. 215–218, May, 1907.)—In 1898 the Weather Bureau at Washington published a paper on West Indian Hurricanes, prepared by the late Viñes, of Havana, for the Chicago Meteorological Congress, 1893. Viñes states that while the lowest air-currents in a cyclone move inward towards the centre, the higher currents diverge more and more, and the cirrus clouds move in "a completely divergent radial direction." "If the vortex lies to the south-south-east, the cirrus clouds will move from the south-south-east, even at so great a distance as 550 miles." This statement, the author points out, contradicts the law that in the Northern Hemisphere air currents tend to curve to the right. The author studies the relations by observing the cirrus movements on St. Croix, one of the Danish Isles, and examining the records of cyclones by Page and others. The cyclones are those of Oct. 1905, Sept. 1 to 9, 1906—which appears to have been succeeded by another cyclone in the middle Atlantic—the great Pensacola storm of Sept. 28, which started off the north coast of South America, and the cyclone of Central America and Cuba of Oct., 1906. He does not believe that the upper currents move, during the hurricane seasons, from an eastern quarter, though the currents from the west are disturbed by cyclones, while outside the hurricane season they very rarely deviate from the westerly origins. H. B.

1798. *Indian Ocean Meteorology and the South-west Monsoon.* **C. W. Brebner.** (Soc. Arts, Journ. 55. pp. 1055–1058, Oct. 4, 1907.)—The author, master of a steamship with twenty-five years' experience of the Indian Ocean, draws attention to the failure of the monsoon of 1905 and to the distinct changes that he supposes to have taken place in the atmospheric conditions of the Indian Ocean and of the Arabian Sea in late years. He shares the belief that heavy snowfalls in the Himalaya districts cause drought, and discusses the repeatedly suggested connection between a prominent south-east trade reaching up to the Equator and beyond it into the Northern Hemisphere and the south-west monsoon, and other assumptions. Cyclones have become common in the Mozambique Channel, where they were unknown a decade ago. Kite stations should be established in Mauritius and on other islands by co-operation of the Governments and authorities. **G. Birdwood.** (Ibid. pp. 1070–1072, Oct. 11, 1907.)—In connection with Brebner's article Birdwood has written a general article for the *Times*, which is here reprinted. H. B.

1799. *The Elastic Theory of Terrestrial Equilibrium.* **L. De Marchi.** (Accad. Lincei, Atti, 16. pp. 910–916, June 1, 1907.)—In two previous memoirs [Abstracts Nos. 799 and 970 (1907)] the author had shown in a special case how, if an elastic plane surface is under the action of normal forces acting over two parallel rectilinear belts, the surface deformations are partially compensated, as regards their effect on gravity, by corresponding compressions or dilatations of the underlying strata. A and B are the constants of isotropy, that is elasticity of volume and rigidity. If $A = 4B$, *i.e.*, Poisson's constant $\mu = 1/3$, the deep strata compensate only half of the superficial irregularities. For a superficial cavity full of water the water's mass makes the compensation approximately complete, but it remains incomplete in the case of superficial accumulations. In the present memoir the theorem is extended to the most general system of normal forces on the surface, provided that they satisfy the condition $\int N ds = 0$ (N being normal force per unit of surface) extended over the surface. He uses Cesáro's notation—

$$Q = \int N \log \overline{z + r} ds,$$

where z is the vertical height of a point P above or below the plane, and r the distance of P from a point in the plane. Also from Cesáro, $\psi = dQ/dz = \int \frac{N ds}{r}$. The dilatation is then $\theta = \frac{1}{2\pi(A - B)} \frac{\partial\psi}{\partial z}$, and the vertical displacement is $w = \frac{1}{4\pi(A - B)} \psi - \frac{z}{4\pi B} \frac{\partial\psi}{\partial z}$. It is evident that ψ is the potential at P of a distribution of matter of density N over the plane surface, partly positive and partly negative, and in the whole zero. From this follows the whole mathematical theory. Hence the above result that the total compression or dilatation within a region underlying an area of superficial elevation or depression is equal to $-2B/A$ of the volume of that elevation or depression, that is if $A = 4B$ or $\mu = 1/3$, the subterranean compression or dilatation compensates, so far as gravity is concerned, one-half of the superficial dilatation or compression. He notes that $\mu = 1/3$ is rather higher than the value of μ deduced from the observed velocity of the tremblings which precede an earthquake wave. As a rule the compensations above mentioned are not complete, so that for a superficial depression or cavity there is an anomalous diminution, for superficial elevations or accumulations an anomalous increase, of gravity. These results are compared with observations of the effect on gravity of Mont Blanc and of the Tyrolese Alps and other mountains. The author concludes that to explain the equilibrium (isostasi) of the earth's surface it is unnecessary to resort to the hypothesis of the internal fluidity of the earth, which is inconsistent, he says, with astronomical arguments, the ordinary elastic properties of matter being sufficient to explain the phenomena. S. H. B.

1800. *Modern Glaciers and their Movements; the Illecillewaet Glacier, British Columbia.* **W. S. Vaux.** (Eng. Club Phil., Proc. 24. pp. 259–282; Discussion, pp. 282–288, July, 1907.)—The author discusses glaciers in general without entering into controversial theoretical questions, and describes the observation of movement made on the Illecillewaet Glacier, to which most of the illustrations refer. This glacier was discovered in 1888 when the Canadian Pacific Railway was being built. W. S. Green made pole observations on the glacier in 1888, and since 1899 the author, who had visited the glacier several times previously, has conducted regular plate observations every year. By 1906 all the original eight plates had been lost in crevasses or had stranded on the moraines, and six new plates were fixed. The average daily glacier motions in 1906 was 7 in., 11 in. near the centre; Green had found 20 (centre) and 7 (sides) ft. in 12 days. The tongue of the glacier has been receding at irregular rates, from 16 to 64 ft. a year up to 1903, by 5¼ and 2¼ ft. in 1904 and 1905, and by 84 ft. in 1906. H. B.

1801. *The Paroxysms of Stromboli.* **A. Riccò.** (Comptes Rendus, 145. pp. 401–404, Aug. 12, 1907.)—The author analyses the statistics tabulated by Mercalli on the behaviour of Stromboli since 1891, with the object of finding relations between the volcanic activity and other phenomena. The distribution of the 28 (not dangerous) outbreaks over the seasons is: winter 3, spring 9, summer 12, autumn 4. Rains are abundant in Italy in autumn and winter. The barometer was on active days rather high (765 mm.) in the morning, while the sirocco, which is supposed to make the Stromboli smoke column larger, comes at low pressure. More than half of the outbreaks coincided with periods of increased luni-solar attraction. There is no connection between Stromboli and the outbreaks of Vesuvius, Vulcano, Etna; the great eruptions of Etna, 1892, and of Vesuvius, 1906, did not affect Stromboli, and during the disastrous Calabrian earthquakes of 1894 and 1905 Stromboli was quiet. Since May 5, 1907, it has again been active. H. B.

1802. *Earthquakes recorded at the Samoa Observatory in* 1906. **F. Linke.** (Gesell. Wiss. Göttingen, Nachr., Math.-Phys. Klasse, 2. pp. 267–269, 1907.)—The Wiechert pendulum (1,000 kg.) at Apia recorded 188 earthquakes originating at distances of less than 1,000 km., and 141 from greater distances. The "near" earthquakes show a maximum in March and a minimum in August. But this relation was reversed in 1905; the 1905 maximum was, however, connected with the eruption on Savaii (one of the Samoa Archipelago islands), the crater of which volcano has since been discharging its lava into the sea through subterranean passages 12 km. in length, mostly without disturbance. As regards the lunar period, both the far and the near earthquakes had their maxima about new moon. H. B.

1803. *Spectroscopic Study of Comet Daniel,* 1907 *d. Peculiarities of the Tail.* **H. Deslandres** and **A. Bernard.** (Comptes Rendus, 145. p. 445–448, Aug. 2, 1907.)—The photographic observations described in this note were made by means of prismatic cameras with no slit. The method, which combines simplicity with small loss of light, gives the spectrum of the entire comet. There is a certain amount of overlapping of the rays, but this inconvenience may be diminished, for a given length of spectrum, by shortening the focal length. The method is especially suitable for a first general survey. One of the cameras employed had a flint prism of 60° and a portrait lens of 21 cm. focal distance (aperture ratio $\frac{1}{4}:4$); the other had a prism and objective of quartz (aperture ratio $\frac{1}{15}$). They were attached to an equatorial mounting, the edge of the prism being set parallel to the comet's tail. The same mounting carried a 6-in. visual telescope, and a small ordinary camera. Photographs were obtained on Aug. 9, 15, and 20, Lumière "Σ" plates being usually employed. The ordinary cometary spectrum appears sharp and intense; it includes the yellow, green, and blue (λ473) hydrocarbon bands, and also the ultra-violet cyanogen band (λ388) first recognised by Huggins in the comet of 1881. The hydrocarbon bands give the impression of not having their maximum of intensity at the more refrangible side, but this point can only be decided with a slit spectrograph. A photograph with the flint prism on Aug. 20 is the richest in detail. On it the cyanogen band is the most intense in the spectrum (a result confirmed by the quartz camera), and appears with two edges, the principal one at λ388, and the more refrangible at λ387. Besides these strong bands this plate shows faint bands, having their middle points at λ455, 426, and 402, which offer one striking peculiarity. They reach into the tail as far as 45 minutes of arc from the nucleus; while the strong bands are only found near the nucleus, and the last is the faintest. This would indicate that the tail has a hydrocarbon spectrum of special type, differing from the ordinary hydrocarbon spectrum, relatively intense, emitted by the nucleus and head. This result only applies to the region within the reach of ordinary plates. The chemical origin of these bands has not been settled. The central band (λ429–423) is very near a strong band emitted by the blue cone of the Bunsen burner, and distinct from the hydrocarbon series. However, the existence of these faint bands in the tail has only been revealed by a single plate, and requires confirmation before being accepted as a certainty. Weather, &c., prevented further confirmation at Meudon, but the result announced may be of service to astronomers in mountain, or other more favourable, situations. Observations have also been made with slit spectrographs by Bosler, but their description is reserved for a later note. A. E.

REFERENCES.

1804. *Machine for Weighing the Forces on a Cutting Tool.* **J. F. Brooks.** (Engineering, 84. pp. 268 and 269–270, Aug. 23, 1907. Paper read before the British Assoc. at Leicester. Elect. Engin. 40. pp. 343–345, Sept. 6, 1907.)—Illustrated, with curves and tables of results.

1805. *So-called General Equation of Work in Elasticity of Materials.* **J. Weingarten.** (Gesell. Wiss. Göttingen, Nachr., Math.-Phys. Klasse, 3. pp. 365–371, 1907.)—A criticism of a book by Müller ("Die neueren Methoden der Festigkeitslehre, &c."). It is shown that a fundamental "equation of work" at which Müller arrives in his introduction, and upon which he develops the elastic theory of solids, is essentially the same thing as well-known expressions. F. R.

LIGHT.

1806. *Transparency to Ultra-violet Rays and Chemical Composition.* **E. Zschimmer.** (Phys. Zeitschr. 8. pp. 611–612, Sept. 15, 1907. Communication from the Jenaer Glaswerk.)—A communication of observations made some years ago during the preparation of UV glasses. A table is given of 19 glasses, with their composition and minimum wave-length transparency. The transparency is greatest with pure B_2O_3 and SiO_2, and it is diminished by the addition of oxides. The meltings, however, were not of great practical use, as they were not sufficiently constant in air, and they contained too many fine gas-bubbles and tended to crystallise. The final results were, therefore, only of directive value in connection with the making of UV glasses.
G. E. A.

1807. *New Method of determining the Axial Angle of Crystals.* **E. Sommerfeldt** and **H. Happel.** (Phys. Zeitschr. 8. p. 611, Sept. 15, 1907.)—A section of the crystal is taken perpendicular to the median line between the axes, and set up at 45° to the principal planes of two crossed nicols. Measurement of the distance apart of the hyperbolas seen is made by means of a scale on the plane surface of the lowermost condenser lens of the horizontal polarisation microscope employed. If the angle α between the axes of a known crystal is already known, and the axes appear at $+a$ and $-a$ divisions on the scale for the latter crystal, and at $+b$ and $-b$ for the unknown crystal, then $\sin\beta/2 : \sin\alpha/2 = b : a$ gives the angle β between the two axes.
G. E. A.

1808. *Light dispersed from Fine Lines or Transmitted by Narrow Slits.* **Rayleigh.** (Phil. Mag. 14. pp. 350–359, Sept., 1907.)—The problem of the incidence of plane waves upon a cylindrical obstacle, whose radius is small in comparison with the length of the waves, and whose axis is parallel to their plane, is considered by the author in "Theory of Sound," § 343, and "Scientific Papers," iv., p. 314; but the approximation is here carried further, and deals with light dispersed from very fine lines ruled upon a reflecting surface or transmitted by very narrow slits. The reflection in the former case is supposed perfect, and the problem is approached by dealing first with a semi-cylindrical obstacle on the reflecting surface instead of a groove in it. Solutions are obtained for light polarised parallel and perpendicular to the lines, and the amount of polarisation introduced if the incident light is unpolarised is also obtained. The work was undertaken to throw light upon the phenomena observed by Fizeau and the author as to the strong and sometimes complete polarisation of the light dispersed from fine lines upon silver.
E. H. B.

1809. *Contribution to Theory of Dispersion.* **L. Mandelstam.** (Phys. Zeitschr. 8. pp. 608–611, Sept. 15, 1907. Phys. Inst., Strassburg.)—All electromagnetic theories of dispersion in homogeneous non-conductors assume the view that a transparent substance is characterised by its molecules being or containing electromagnetic resonators, and Planck's theory is distinguished from others by his view that the dispersion of energy by the resonators is the cause of extinction. Planck's equations are employed in an investigation which gives the result: An optically homogeneous medium with the properties assumed does not disperse the transmitted light. Since gases may also be considered as optically homogeneous media, it follows that no dispersion by their molecules should be expected. If this be the case, the colour of the sky is to be attributed to foreign particles suspended in the atmosphere which make the whole an optically non-homogeneous medium. [See also Abstract No. 1845 (1907).] G. E. A.

1810. *Physiological Basis of Illumination.* **L. Bell.** (Amer. Acad., Proc. 43. No. 4. pp. 77–96, Sept., 1907.)—The fundamental fact at the basis of vision is that the eye can perceive, over a very wide range of absolute intensity, a practically constant fractional difference (*d*I/I) of luminosity (I). This fractional difference is generally called Fechner's fraction. Its value for normal eyes and ordinary intensities of illumination varies from 0·02 to 0·0055. This law is of the highest practical importance. In a room well lighted by daylight, for instance, the illumination varies in different parts of the room from 10 to 100 metre-candles, and if Fechner's fraction varied much with illumination, we should be half-blind most of the time. In cases of abnormal vision *d*I/I is sometimes as great as 0·1, and the patients are apt to stumble in broad daylight. If *d*I/I were as great as 0·5 no contrast less than that between black and white could be distinguished. A great power of distinguishing small differences of luminosity is not necessarily associated with great keenness of vision. Great acuity, generally associated with slight hypermetropia, is not uncommon amongst savage tribes. The failure of acuity in a dim light is familiar to every one, and its variation with intensity must be known in order to produce the best artificial illumination. Enough light must be provided to bring the eye to its normal acuity, as well as to its normal value of Fechner's fraction. A diagram is given illustrating that when the light reaching the eye has risen to 10 metre-candles, further increase does very little in the way of assisting practical vision. The aperture of the iris of the eye may vary in diam. from less than 1 mm. up to the full diam. of the visible iris, which in the dark sometimes retreats within the rim of the cornea. The iris, acting as a stop behind the strongly refracting cornea, produces a certain amount of "pincushion distortion." The author's experiments prove that the expansion of the iris is less to protect the eye at high intensities than to strengthen the retinal image at low intensities. A glow-lamp filament is an excellent source for studying irradiation. At a distance of 2 m. the apparent diam. of the filament when fully incandescent is 4 or 5 mm. Using the wedge photometer upon it, the diminution of apparent diam. is at first rapid, until it falls to about 0·5 mm., at which it remains nearly constant until it vanishes. At a few hundredths of a metre-candle most of the irradiation has disappeared. The apparent breadth of the filament decreases without any marked shading off at the edges, just as if a slit were being closed. From a practical standpoint flicker is troublesome in direct proportion to its magnitude and inversely to its frequency. With lamps of ordinary voltage and c.p. the flickering is perceptible with alternating currents when the frequency lies between 20 and 30. The new high-efficiency lamps are worse than the old ones in this respect. Since selective radiation is necessary for high efficiency it is probable that the colour question of artificial illuminants will be a most important question in the immediate future. We have to deal with the yellow of the flame arc, the yellowish green of the Welsbach, the blue green of the mercury tube, and the violet of the enclosed arc. The author shows a curve illustrating the passage from predominant rod to predominant cone vision. It is stated that the exact point at which the colour-sensitive cones begin to come into action varies greatly in different eyes, and in the same eye in different conditions of adaptation. As the illumination is progressively diminished, colour vision gets more and more imperfect and uncertain, especially towards the red end of the spectrum. The Purkinje phenomenon is now known to depend on the progressive failure of cone vision. It would be of great value to get proper tests for luminosity made in cases of congenital hemeralopia, where the rods in the eye are inactive and the cones normal. Tests for the reverse case, cones inactive and rods normal, prove that the patients have no colour perception. Acuity of appreciable magnitude is chiefly an attribute of cone vision. The extremely sharp definition given by the flaming calcium arc and the mercury arc are mainly due to improvement in the conditions of the chromatic aberration of the eye. There is, however, the inherent danger of throwing too much work on part of the visual apparatus of the eye, when strongly coloured or monochromatic lights are used. A nearly white light with its maximum luminosity near the normal wave-length is probably the one which puts least stress on the visual apparatus. A. R.

1811. *International Photometric Commission.* (Electrician, 60. pp. 6–7, Oct. 18, 1907.)—At the third meeting of the International Photometric Commission held at Zürich in July, 1907, the following resolution was adopted: "The International Photometric Commission . . . accepts the following values for the ratios of the luminous intensity of the flame standards now in use: Carcel/Hefner $= 10{\cdot}7_5$, Harcourt/Hefner $= 10{\cdot}9_5$, and Hartcourt/Carcel $= 1{\cdot}02_0$." The maximum possible inaccuracies of the above ratios are stated to be within 1 per cent. The values apply to the luminous intensities (in the standard directions) of the lamps when burning under the following atmospheric conditions: Barometic pressure, 760 mm.; humidity, 10·0 litres of water vapour per m.^{3} of dry air for the Carcel and Harcourt, and 8·8 litres of water vapour for the Hefner lamp. C. C. Paterson points out that some of the discrepancies in the measurements can be explained by differences in the methods adopted of measuring humidity. It was decided that for the present measurements should be made by the ventilated hygrometer, as the results obtained by it in photometric work with flame standards were the most consistent and probably the most accurate. A. R.

1812. *Devices facilitating the Study of Spectra.* **W. N. Hartley.** (Roy. Dublin Soc., Proc. 11. 19. pp. 237–242, Aug., 1907.)—This paper deals with the methods of observing flame spectra and describes the best method of production. As support for the substance thin slips of cyanite are recommended, or strips of a mixture of carborundum and porcelain clay which has been fired at a high temperature. Again, quartz fibres or rods may be used. The best burner is the Mecke with or without blast. For obtaining a lasting chloride spectrum the author recommends feeding the burner with gas mixed with a little chloroform. E. C. C. B.

1813. *Polarisation of Light by Refraction.* **C. Fabry.** (Comptes Rendus, 145. pp. 112–115, July 8, 1907.)—Deals with Salet's argument [see Abstract No. 1182 (1907)] that there can be no strong refraction of light within the sun as there is no polarisation. Points out that a strong deviation does not necessarily produce a large amount of polarised light if produced by a large number of successive refractions. A deviation of 45°, produced by a single refraction, would give 88 per cent. of polarised light. The same deviation produced by ten successive refractions would only give 8 per cent., and as the number of successive refractions becomes very large, the percentage of polarised light approaches zero. A condition in which the refractive index changes gradually may be obtained by pouring petroleum essence carefully over carbon disulphide. A beam incident into the liquid shows no perceptible reflection, such as it would do if there were an abrupt transition. There being no reflection there can be no polarisation. It follows that the theory of solar refraction advanced by Schmidt and Julius is not invalidated.

E. E. F.

1814. *Arc Spectra under Heavy Pressure.* **W. J. Humphreys.** (Astrophys. Journ. 26. pp. 18–35, July, 1907.)—An extension of the previous work upon the shift of the arc spectrum lines under pressures. The pressures dealt with are 42, 69, and 101 atmos., and photographs obtained with a large concave grating contain the spectrum of the arc under ordinary pressure and also the spectrum of the arc under high pressure, the two spectra being in juxta-position. The apparatus is described in detail in a separate paper [see Abstract No. 1909 (1907] and complete tables are given showing the shifts observed at the three different pressures. The elements dealt with are Al, Ba, Ca, Cr, Co, Cu, Fe, La, Pb, Mg, Mn, Ni, Pd, K, Si, Sr, Ti, W, and Zn. The results briefly stated are the following: The brilliancy of the arc increases with the pressure and the reversals are more frequent and pronounced. The pressure generally increases the width of the lines and tends to make them nebulous, this being true for the lines of the cyanogen bands even though these are not appreciably displaced. The wave-lengths of all other lines, whether reversed or not, increase approximately proportionally to the pressure, though this increase is very different not only for different elements, but also for different lines of the same element. In general, the pressure-shift seems to increase with the wave-length, but probably this is true only of lines belonging to the same harmonic series. There appears to be direct connection between the pressure-shift and the Zeeman-effect, inasmuch as those lines which show large shifts are widely separated in the magnetic field, and *vice versâ*. The shift seems to be a function of the total, and not the partial, pressure and is only a small part of that which would be expected if the luminous particles behaved like Hertzian oscillators. E. C. C. B.

1815. *Quantitative Spectra of Barium, Strontium, Calcium, Magnesium, Potassium, and Sodium.* **J. H. Pollok** and **A. G. G. Leonard.** (Roy. Dublin Soc., Proc. 11. 18. pp. 229–236, July, 1907.)—A continuation of the work described in a previous paper [see Abstract No. 1510 (1907)]. It was found that in sparking strong solutions the atmosphere became charged with the vapour and it was impossible to measure the persistence of the lines with dilution. The difficulty was met by working backwards from the most dilute solutions towards the strong solutions, finally sparking the metal when possible.

E. C. C. B.

1816. *Absolute Measurement of the Zeeman-effect.* **F. Paschen.** (Phys. Zeitschr. 8. pp. 522–523, Aug. 15, 1907.)—The results are given of measurements of the magnetic separation $K = \Delta\lambda/\lambda^2 H$, which are considered to be more exact than those of Weiss and Cotton [see Abstract No. 1582 (1907)]. Much care is taken to measure the magnetic field of the electromagnet with accuracy, the ballistic method being employed in conjunction with a magnetic standard [see Abstract No. 1915 (1907)]. The value of K found by Frau A. Stettenheimer was 1·901, as compared with 1·818 by Färber and 1·875 by Weiss and Cotton. The lines Cd4678 and Zn4680 were employed, and it is found from Gmelin's experiments with an echelon that the separation is proportional to the field strength between the limits 3,500 and 35,000 Gauss. According to Runge and Paschen's laws, the separation of the above lines is double of that for lines designated by Runge as normal triplets, and Lorentz's theory gives for e/m the values $1·767 \times 10^7$ (Weiss and Cotton) and $1·791 \times 10^7$ (A. Stettenheimer). The applicability of Lorentz's theory to these normal triplets is then discussed. G. E. A.

1817. *Variations of Absorption Bands of Parisite and Tysonite in a Magnetic Field at Liquid-Air Temperature.* **J. Becquerel.** (Comptes Rendus, 145. pp. 413–416, Aug. 19, 1907.)—With parisite under a magnetic field R of 15,000 Gauss shifts ($\Delta\lambda$) of the various bands were obtained of the orders 0·02 $\mu\mu$ up to 0·289 $\mu\mu$. The quotients, charge divided by mass, were then deduced from the equation, $e/m = 2\pi v(\Delta\lambda/\lambda^2)(1/R)$, and furnished values of e/m ranging from $-1·88 \times 10^7$ to $+11·56 \times 10^7$. With tysonite under the same field shifts from $\Delta\lambda = 0·01$ $\mu\mu$ to 0·827 $\mu\mu$ were observed, giving for e/m the values $-0·7 \times 10^7$ and $\pm 10·52 \times 10^7$ respectively. These values point to the conclusion that there are corpuscles possessing a mass only *one-sixth* that of the kathode corpuscles. [See also Abstract No. 1846 (1907).] E. H. B.

1818. *Band Spectra of Mercury Halogen Salts.* **J. Lohmeyer.** (Zeitschr. Wiss. Phot. 4. pp. 367–383, 1906. Chem. Zentralblatt, 1. p. 396, 1907. Abstract.)—Using a Rowland grating of 1 m. curvature the author has photographed the spectra of mercuric chloride, bromide, and iodide. The bands could not be separated owing to the smallness of the dispersion. It is found that the band system moves towards the violet as the atomic weight increases, in opposition to the motion found by Wedemann (Boltzmann Festschrift, p. 826, 1904). L. H. W.

1819. *Band Spectra of closely allied Compounds.* **C. M. Olmsted.** (Zeitschr. Wiss. Phot. 4. pp. 255–291, 1906. Chem. Zentralblatt, 1. pp. 146–147, 1907. Abstract.)—The band spectra of the halogen salts of the metals Ba, Sr, Ca, and Mg were photographed and compared with the Fe spectrum taken for comparison on the same plate. It is found that the spectra consists of a series of bands, each band being composed of a large number of lines. There is a readily traceable relationship between the position of the bands and the atomic weight. In the case of Ca, Sr, and Ba the chlorides of these metals give spectra which have a much greater resemblance than the spectra of the fluorides. It is concluded that the more the atomic weights of the components approach equality the greater is the emissive power of the molecule. For a given halogen salt, the lower the atomic weight of the metal, the greater is the apparent displacement of the bands towards the violet. The only exceptions appear to be the chloride and fluoride of magnesium. No band was seen in the spectrum of beryllium chloride. The equation $N = A \pm (Bm + C)^2 = \alpha + \beta m + \gamma m^2$ is found to hold for the lines of all the bands; here $N =$ frequency, A, B, C, α, β, γ are constants, and m is the series of positive integers. The absolute values of α and β for each metal vary inversely as the atomic weight of the halogen. The γ value depends solely on the atomic weight of the metal. L. H. W.

1820. *Doppler-effect with Canal Rays.* **J. Stark, F. Paschen.** (Ann. d. Physik, 23. 4. pp. 798–804, Aug. 22, and 23. 5. pp. 997–1000, Sept. 24, 1907.)—The first paper is a criticism of the work of F. Paschen on canal rays [see Abstract No. 1348 (1907)]. The chief point to which Stark takes exception is that the displacement is identical for all the lines of the hydrogen series. In an earlier paper [see Abstract No. 57 (1907)] the author has shown that the maximum blackening of the photographic plate and the position of minimum displacement are more displaced in the lines of shorter wave-length than in those of longer wave-length. It is now suggested that the discrepancy arises from the fact that Paschen takes the position of greatest blackening to be that of greatest intensity, and that owing to the diffusion and reflection of light by the photographic plate the position of apparent maximum is displaced towards the middle of the line; and further, that if the point at the extremity of the lines in Paschen's photographs be considered as the position of the maxima instead of the positions of greatest blackening, the observations will be found to be concordant with the author's. In reply to Stark, it is now pointed out by Paschen that the position of the maximum of the displaced line can be determined as accurately by observing the maximum blackening of the photographic plate as by a measurement of the position of the tips of the lines, since when one is indefinite the same objection applies to the other. Also the disturbing effect of diffusion and reflection has been minimised by using films instead of plates without in any way altering the result. Paschen also maintains that his observations upon the Doppler-effect in oxygen are the most reliable that have been made up to the present. [See also Abstract No. 640 (1907).] S. G. S.

1821. *Fluorescence at very low Temperatures.* **A. Heiduschka.** (Archiv der Pharmacie, 244. pp. 569–571, 1906.)—Deals with observations of the behaviour of a number of substances at liquid-air temperature, of which a few are selected. (1) Alcoholic solutions of indigotinsulphonic acid and of some sulphur dyes become fluorescent. (2) The fluorescence of an alcoholic solution of methyl-violet BB is not diminished by addition of aniline in equal quantity, although there is no fluorescence with a solution of aniline in this solvent. (3) An alcoholic solution of methylene-violet RRA has its fluorescence removed at room temperature by chrysoidine, but recovers some of its fluorescence at the low temperature. L. H. W.

1822. *Atomic Weight of Nickel.* **C. G. Barkla** and **C. A. Sadler.** (Phil. Mag. 14. pp. 408–422, Sept., 1907.)—In a paper on secondary Röntgen radiation [see Abstract No. 1284 (1906)] Barkla suggested a method of determining atomic weights by means of experiments on the more penetrating secondary rays. The behaviour of nickel was so remarkable that further investigations were undertaken. The properties of secondary rays were thoroughly dealt with, and some interesting tables of results are given. From their experiments the authors conclude that the true atomic weight of Ni is approximately midway between those of cobalt and copper—very probably about 61·4. The principal points of interest in connection with the theory of secondary radiation brought out during these experiments are the following: The periodic relation between absorbability of the secondary rays and the atomic weight of the radiator obtained by experiments with Al as the absorber, is a true relation between the *general* absorbability of the radiation emitted by different atoms and their weight; for the variation in the penetrating power of the secondary radiation with variation in atomic weight of the radiator is practically the same with all substances used, except in the case of special relations existing between the radiator and absorber. The secondary Röntgen rays emitted by certain substances are remarkably homogeneous in character, though the primary radiation producing them is very heterogeneous. This, however, is not true of the Röntgen radiations proceeding from all elements, even among those which emit a radiation differing considerably from the primary in character. Change in the penetrating power of the primary beam has not been found to affect the penetrating power of the secondary from these substances, within certain limits in the character of the primary. The remarkable penetrating power of the secondary radiations can only be due to the fact that the radiating substances exercise a selective absorption. The research is being continued, and a fuller discussion of the results will be given in a succeeding paper. In a note of Aug. 1, 1907, referring to the work of Parker and Sexton [see Abstract No. 1697 (1907)], who found that the atomic weight of Co was 57·7, the authors state that from the results of the first two series of experiments described in this paper it must be concluded that there is a marked probability of the accepted atomic weight of Ni being much too low. The value 59 has consequently been accepted for Co. A. W.

1823. *Corpuscular Rays produced by Röntgen Rays in different Metals.* **C. D. Cooksey.** (Amer. Journ. Sci. 24. pp. 285–304, Oct., 1907.)—When Röntgen rays fall on a metal there are produced secondary Röntgen rays and corpuscular rays which are a species of β-ray. By a method which eliminates the ionisation due to the primary and secondary Röntgen rays, the relative number of the corpuscular rays emitted by different metals is studied. The method is rather complicated to describe in an abstract, but a summary of the chief results is given. The velocities found from the absorption in aluminium are in agreement with those found by other investigators, notably Seitz; the more penetrating primary rays produce more penetrating secondary rays. For the more penetrating primary rays used, the secondary rays from the different metals vary little in penetrating power; nickel is an exception. For less penetrating primary rays the secondary rays vary greatly in penetration. Those possessing great penetrating power are very homogeneous, and are absorbed according to an exponential law. With the exception of silver, the number of corpuscles produced in different metals, for equal absorption of the primary rays, increases with the density. R. S. W.

1824. *Secondary Rays.* **C. Füchtbauer.** (Ann. d. Physik, 23. 2. pp. 301–307, June 18, 1907. Phys. Inst., Würzburg.)—Last year [see Abstract No. 747 (1906)] the author found that the secondary rays elicited by either canal rays or kathode rays, of different velocities, have the same characteristic speed, viz., about $8{\cdot}4 \times 10^8$ cm. per sec. This fact points to a common origin of both classes of secondary rays, and the author finds this in the kinetic energy of the metallic atoms, from which the electrons are liberated as in gaseous ionisation. This view is corroborated by the fact that the velocity is the same whether the secondary rays are emitted by Pt or by Al. It is also the same as that of the slow negative rays emitted by polonium, as measured by

Ewers. Wien has formulated a similar hypothesis for the secondary rays due to Röntgen radiation, as it was inconceivable that their velocity could be produced by a single impulse. Lenard found that the ionisation of gases by kathode rays gives rise to slow secondary rays. The strong increase of secondary radiation at slanting incidence is due to the lessening of the absorption, the secondary rays having less metal to traverse before emerging. E. E. F.

1825. *Low Pressures of Radio-active Products observed with the Radiometer.* **J. Dewar.** (Comptes Rendus, 145. pp. 110–112, July 8, 1907. Roy. Soc., Proc. Ser. A. 79. pp. 529–532, Sept. 6, 1907. Chem. News, 96. pp. 97–98, Aug. 30, 1907.)—If a carbon absorber is plunged in solid hydrogen together with an open radiometer tube, and the gas in the tube is hydrogen, the pressure in the tube is so much reduced that the vanes no longer turn when exposed to radiant heat. But if the residual gas is helium the vanes do not stop [see Abstract No. 1864 (1907)]. When the gas is mercury vapour the vanes can be made to stop by employing liquid air as a refrigerator, but motion recommences at −23° C., when the mercury vapour has a pressure of a fifty-millionth of an atmosphere. This suggests a new method of testing the final products of radio-activity. The author enclosed some radium bromide in a side tube, condensed the emanation in an absorber plunged in liquid air, and waited till the radiometer vanes began to turn again in an arc-light beam. This took place after 15 hours. Condensation by liquid hydrogen had no stopping effect, therefore the gas evolved could not be hydrogen. The author concludes that it is helium, with or without an admixture of α-particles. The author is now investigating radiation-pressure in the highest attainable vacuum. E. E. F.

1826. *Properties and Nature of various Electrical Radiations.* **W. H. Bragg.** (Phil. Mag. 14. pp. 429–449, Oct., 1907. Paper read before the Roy. Soc. of South Australia.)—A consideration of past work on the ionisation produced by the various ionising agents, α-, β-, γ-, and Röntgen rays, leads the author to the conclusion that the bulk of the ionisation they produce is of the same character, and consists in the displacement of slow-moving electrons, or δ-rays, from the atoms of gas or other substance which they traverse. Moreover, there is some evidence to show that the speed of the δ-rays is almost independent of the cause and manner of this production. This speed is of the order 10^8 cm./sec.; below this speed the electron is unable to leave the parent atom. The existence of this common speed for all δ-rays may imply that the ejection is not directly affected by the ionising agent, but that the latter simply precipitates the discharge. On the question of absorption the author criticises J. J. Thomson's investigation of the motion of a stream of β-particles through an absorbing layer. The various radio-active substances emit positively and negatively charged particles; the possibility is considered of an emission of neutral particles—*e.g.*, a pair consisting of one α- and one β-particle. It is known that the α-particle loses speed on entering an atom, and the field about it is the main cause of this loss of energy. In the pair this field is greatly contracted, and therefore the penetrating power may be very great, and its ionising power correspondingly reduced. If from any cause the moment is increased we should have an increase in ionising power. Such a pair would be incapable of deflection by magnetic or electric fields, would show no refraction, and it is conceivable that it might show a one-sidedness or polarisation, for if it were ejected from a rotating atom it would itself possess an axis of rotation. It would thus show the properties of a γ-ray. It may at last suffer some violent encounter which will resolve it into an α- and β-particle; the latter possessing much the greater velocity would appear as a secondary ray. The rayless changes that are known to occur may really consist of an emission of these pairs. Reasons are also given for considering Röntgen rays to consist of ether pulses and pairs of small moment, and this is not rendered impossible by the experiments of Marx on the velocity of these rays. R. S. W.

1827. *Production of Helium from Radium.* **W. Crookes.** (Chem. News, 94. p. 144, Sept. 21, 1906.)—A small vacuum tube having beads of radium bromide fused on to the ends of its Pt electrodes was exhausted and sparked, CO_2 being evolved; again exhausted and sparked, with further evolution of CO_2. No helium was, however, detectable. Examined after an interval of four months, the helium line λ5875·9 was distinctly visible. Although too faint to be measured, the parhelium line was also observable. L. H. W.

1828. *Atomic Weight of Radium.* **Mme. Curie.** (Comptes Rendus, 145. pp. 422–425, Aug. 19, 1907. Chem. News, 96. p. 127, Sept. 13, 1907.)—Working with 9 cgm. of radium chloride, the atomic weight of radium has previously been found to be 225 [Abstract No. 264 (1903)]. A larger amount—viz., 4 dgm.—has now been obtained and a redetermination effected. The methods are those of the previous paper. The purification is attained by fractional crystallisation from a hydrochloric acid solution, or by precipitation by alcohol from the aqueous solution. The progress of the purification is tested by photographs of the spark spectrum; the strong barium line, 4554·4, and the radium line, 4533·5, are the lines observed. It is found necessary to conduct the operations in porcelain vessels, otherwise radium sulphate is formed. The water of crystallisation is got rid of by heating to 150°. The chlorine of the radium chloride is weighed as silver chloride, and supposing radium is divalent, the mean of three concordant determinations gives the atomic weight as 226·18. The authoress does not consider the difference between this and the former result as due to the greater purity of the radium chloride in the later experiments, but as arising from the greater ease of the manipulation of the larger quantity of material. R. S. W.

1829. *Action of Gravity on the Radio-active Deposit.* **Mme. Curie.** (Comptes Rendus, 145. pp. 477–480, Sept. 2, 1907.)—Some years ago P. Curie noticed that when radium emanation is confined in a vessel whose walls are covered with zinc sulphide, the luminosity is concentrated near the bottom of the vessel. This action of gravity is here studied by the electrical method. Emanation is introduced into a vessel in which are placed a number of pairs of metallic plates, some of which are horizontal, others vertical. These become active on account of the active deposit they receive, and after a few days this activity is tested in the usual way. The vertical and the under sides of the horizontal plates are equally active; the upper sides of the horizontal plates are from two to five times more active. The question is, are the particles of the active deposit sufficiently great to acquire the velocity of fall required by these results? Dust particles are not necessary to the action; water vapour, on the other hand, bears an important part. If the gas in the vessel is thoroughly dried no such concentration on the upper sides of the plates occurs. It is also suppressed if the plates are within 2 mm. of each other. R. S. W.

1830. *Rate of Transformation of Radium Emanation.* **G. Rümelin.** (Phil. Mag. 14. pp. 550–558, Oct., 1907.)—Two methods have previously been used to measure the rate of transformation of the emanation; one in which the decay of a quantity of the gas is measured in a closed vessel, the other in which known volumes of air containing emanation are transferred into the testing vessel after known intervals of time. The disadvantage of the first method is that it requires measurements of currents over a wide range of intensity; the drawback of the second is that during transference the homogeneous distribution may be disturbed. The author uses a different procedure. Let two volumes V_1, V_2, communicating with each other, be filled with air containing emanation uniformly distributed. Disconnect them; then if at time $t=0$ the smaller volume when passed into an electroscope produces a current i_1, and at time t later the volume V_2 gives i_2, the half-value period T is given by $T = t \log 2/[\log(V_2/V_1) - \log(i2/i1)$. In the experiments t varied from 6 to 14 days; the electroscope was standardised by using the γ-rays from a small quantity of radium. As the mean of eight results $T = 8{\cdot}75$ days. The readings are not taken until the emanation has been in the electroscope for 3 hours. R. S. W.

1831. *Reflection and Absorption of β-Rays.* **H. W. Schmidt.** (Ann. d. Physik, 23. 4. pp. 671–697, Aug. 22, 1907. Physikal. Inst. d. Univ., Giessen, June 15, 1907.)—In a previous paper the author has demonstrated the possibility that the apparent absorption of β-rays by a metallic sheet is due to their dispersion, the rays which are transmitted being unchanged in velocity [see Abstract No. 1516 (1907)]. In the present paper expressions are obtained for the intensity of radiation transmitted and reflected in a direction normal to the sheet in terms of the thickness of the sheet and two coefficients, one of reflection and the other of real absorption, *i.e.*, transformation into energy of another form. The method of treatment is similar to that employed in the case of light reflected by a pile of plates, with the exception that in this case we have a surface reflection and in the case of the β-rays we have a volume reflection. In order to minimise the effect of lateral dispersion, the active material, which consists of a layer of UrX upon a thin sheet of Al, is in the form of a circular surface of 8 cm. diam. A sheet of the metal under investigation is placed between the active layer and the electroscope as previously described, and the effect due to reflection is determined by finding the relative increase in effect produced when a second sheet of the metal is placed upon the radio-active layer. The results are fairly in accord with the formulæ. The reflection increases with the thickness of the reflecting layer, but soon reaches a maximum; but this maximum is reached more rapidly the higher the atomic weight of the metal employed. The effect of dispersion in all directions is next investigated; the law of absorption is found to be an exponential one when the thickness is considerable, but the exponential law is departed from in the case of thin layers, there being a difference in this respect to the behaviour towards light. A table of results for α and β, the real coefficients of absorption and reflection for various metals, is given, and from this it appears that $100\beta/AD = 12{\cdot}4$ and $(\alpha/D)\sqrt[3]{A} = 11{\cdot}2$, where A is the atomic weight and D the density. These universal constants indicate that the absorption is proportional to the total cross-section of the atoms of the material, and the reflection to the atomic weight and to the total volume of the atoms, that is, to their resultant attracting mass. S. G. S.

1832. *Origin of Radium.* **B. B. Boltwood.** (Amer. Journ. Sci. 24. pp. 370–372, Oct., 1907. Nature, 76. pp. 544–545, Sept. 26, 1907.)—Earlier experiments [Abstract No. 68 (1907)] have indicated the separation of the parent of radium from a solution of a uranium mineral. As it was proved that this substance was not radium, uranium, or polonium, it was assumed to be actinium. It was therefore suggested that actinium is the parent of radium. Further experiments have shown it is necessary to revise this last conclusion. In support of Rutherford's experiments it is found that the production of radium in solutions of the parent is not influenced by the presence of radio-actinum. The production of radium has been constant over a period of 500 days. Contrary to Rutherford's experiments the radium parent cannot be separated from actinium by fresh ammonium sulphide. It can, however, be completely separated by sodium thiosulphate under the conditions usual for the precipitation of thorium. It is probable that Rutherford's sulphide had partially changed to the thiosulphate. The growth of radium is proportional to the activity of the parent. That the active substance is not actinium is demonstrated by the fact that no actinium products can be separated from a solution over five months old. The most conclusive proof that the substance described is a new radio-active element is furnished by its α-radiation. The range of these rays in air is less than 3 cm., smaller than that of any known α-ray. The β-rays are more easily absorbed than those of uranium. The activity of the new element in equilibrium with radium is about 0·8 of the radium itself, about what would be expected from the range of the α-rays. The name ionium is suggested for this new substance. R. S. W.

1833. *Light-emission of Air and Helium under the Influence of α-Rays.* **J. Stark** and **F. Giesel.** (Phys. Zeitschr. 8. pp. 580–583, Sept. 1, 1907.)—Observations were made upon a preparation of polonium in the dark and also by means of photography. From these it appeared that the α-rays in air experienced no marked dispersion but that they proceeded in a straight line, and, moreover, that the secondary kathode rays which are produced by the α-rays in air either do not take part in the production of the light emission, or more probably, as appears to be actually the case, according to observations by Ewers, are very strongly absorbed by air at atmospheric pressure. The range of luminosity of the α-rays in air was found to be 3·85 ± 0·1 cm. When the light produced by the α-rays from the polonium preparation in air was analysed by a small Fuess quartz spectrograph it was found that the α-rays brought to emission besides the positive bands of nitrogen, also its negative bands, and the latter in somewhat greater intensity than the immediately neighbouring positive bands. The α-rays, on their passage through helium, excite it to emission of its line spectrum. An analogy between the behaviour of the canal rays and the α-rays is indicated by various observations in spectrum analysis. J. J. S.

1834. *Some Properties of Uranium and Actinium.* **M. Levin.** (Phys. Zeitschr. 8. pp. 129–133, March 1, 1907. Cavendish Lab., Cambridge, Jan. 24, 1907.)—(1) *Activity of Uranium Nitrate.*—The activity sometimes fall off in time in an irregular way [see Abstract No. 2167 (1904)]. The author has experimentally confirmed his view as to the reason for this falling off, which is that the nitrate absorbs moisture until a liquid phase is formed; and the UrX transfers itself from the crystals to the aqueous solution in greater proportion than does the uranium nitrate. (2) *Radiation of UrX.*—The author employs his animal charcoal method of separating UrX, and from magnetic examination concludes that the α-radiation is at most 10 per cent. of the total radiation. He therefore considers that the more easily absorbed rays which Schlundt and Moore observed [Abstract No. 2106 (1906)] are not α-rays but secondary β-rays which arise from the primary β- and γ-rays of UrX within the active layer. (3) *Electrolysis of Actinium Products.*—The irregularities noticed in the previous paper [Abstract No. 69 (1907)] are explained as being due to occasional separation of RaAc and of Ac itself. (4) *Separation of RaAc by Charcoal.*—This separation of RaAc from nitric acid Ac solution, or of ThB from thorium nitrate solution, can be effected in the same way as the separation of UrX from uranium nitrate solutions.

L. H. W.

1835. *Radiation from Uranium X.* **M. Levin.** (Phys. Zeitschr. 8. pp. 588–589, Sept. 15, 1907. Inst. f. anorg. Chem., Göttingen, Aug. 14, 1907.)—According to Schlundt and Moore, and also Hess, UrX gives out, in addition to the β-rays, an easily absorbed radiation which they identify as α-rays. In an earlier work [see preceding Abstract] the author gives reasons for supposing that these easily absorbed rays are not α-rays; the present paper continues the investigation. The absorption by aluminium is tested; the rays are found to be more penetrating than any α-rays yet known. Hence if they are α-rays, the relative ionisation produced by them and the β-rays ought to be of an altogether different order from what it actually is. The absorption curve for the rays from UrX, moreover, shows no evidence of the rapid removal of any class of ray as the absorbing substance is increased in thickness. In opposition to H. W. Schmidt it is found that the absorption curve does not follow an exponential law. Experiments are also made by Bragg's method to test the range of the rays. These also show no evidence of the presence of α-rays.

R. S. W.

1836. *Ionic Velocity and Valency of Thorium X.* **G. Hoffmann.** (Phys. Zeitschr. 8. pp. 553–555, Sept. 1, 1907.)—From electrolytic experiments the velocity of the ions of thorium X expressed in cm. per hour with a potential gradient of 1 volt per cm. at 18° C., is calculated to lie between 0·80 and 1·20. The number for the ionic velocity deduced, according to the theory of Nernst, from the diffusion coefficient of thorium X, viz., $K = 0{\cdot}504$ cm.^{2}/day, at 10°, is 0·86 cm. per hour with 1 volt per cm. at 10°, and 1·08 cm. per hour at 18°. This is on the assumption that the thorium X ions are monovalent, and a comparison of the number obtained with that got from electrolysis indicates that the assumption is correct.

J. J. S.

1837. *Radio-activity of Thorium Salts.* **B. B. Boltwood.** (Phys. Zeitschr. 8. pp. 556–561, Sept. 1, 1907. Sloane Lab., Yale Univ., June 16, 1907. From the English.)—Measurements of the changes which have occurred in the activity of certain preparations of thorium have resulted in strongly supporting the opinion of Hahn that in the thorium series between thorium and radio-thorium there exists an intermediate product which possesses a small velocity of transformation and sends out no α-rays [see Abstract No. 1647 (1907)]. Certain methods for the separation of this intermediate product from thorium are described. J. J. S.

1838. *Formation of Thorianite and Uraninite.* **B. Szilàrd.** (Comptes Rendus, 145. pp. 463–464, Aug. 26, 1907.)—In these minerals the relation between the uranium and the thorium present does not permit of the supposition that they form together a definite compound. The quantities of uranium and thorium in the minerals are almost always in the following ratio: Thorianite, 4–11 per cent. of uranium and 65–74 per cent. of thorium; uraninite, 65–74 per cent. of uranium and 4–11 per cent. of thorium. A substance has been prepared containing uranium and thorium in the same proportions as thorianite. It was made by dissolving thorium hydrate in a solution of uranyl nitrate. On evaporating the solution after saturation a red body was obtained whose composition as regards uranium and thorium varied within the same limits as in the case of thorianite. By dissolving uranyl hydrate in thorium nitrate a body with composition similar to uraninite was got. Other experiments show that the salts of thorium and uranium have the property of also dissolving the hydrates of rare earths, and of almost all the metals met with in thorianite and uraninite. These bodies are amorphous and of colloidal nature. J. J. S.

1839. *Rate of Decay of the Active Deposit from Radium.* **W. Wilson** and **W. Makower.** (Phil. Mag. 14. pp. 404–408, Sept., 1907. Paper read before the Physical Soc., May 24, 1907.)—In some experiments in which the ionisation produced by the α-rays from radium C was balanced against that produced by the more penetrating β- and γ-rays, it was found that after a short time these two ionisations were no longer exactly equal, however carefully they had at first been adjusted to equality. A similar effect has been noticed by Bronson, and has been attributed to the slowly moving β-rays emitted by radium B, recently discovered by Schmidt. Since these rays are emitted by radium B, whereas the α- and the more penetrating rays are emitted by radium C, it is to be expected that the rate of decay as measured by these two types of radiation will be different. The present paper describes experiments made to test the correctness of this explanation. These verified the supposition and lead to the conclusion that the difference in the rates of decay is due to the slowly moving β-rays emitted by radium B. J. J. S.

1840. *Action of Kathode Rays on Uranium.* **W. P. Jorissen** and **W. E. Ringer.** (Chem. Weekblad, 4. pp. 476–479, 1907.)—When metallic uranium is exposed to kathode rays the activity is increased to over 200 per cent. With metallic Th, Pb, and Bi there is little change in the activity. Uranoso-uranic oxide has its activity increased about 45 per cent. by this treatment, and thorium oxide 25 per cent. In the former case the change is not due to reduction of the oxide to uranium. L. H. W.

1841. *New Radio-active Molybdenum-Uranium Compound.* **A. Lancien.** (Comptes Rendus, 144. pp. 1434–1435, June 24, 1907. Extract.)—When ammonium molybdate is allowed to act upon nitrate of uranyl a precipitate is produced which on examination corresponds to the formula Mo_4UrO_3: it is hence molybdate of uranyl. In the dark the precipitate is an amorphous white powder. After insolation the physical properties undergo a change, and after 80 hours the colour has become golden-yellow. The molybdate is a radio-active body of activity about equal to that of radium barium bromide (of activity 40) and of much greater activity than uranium nitrate. The comparison was made by sealing up the substances in similar tubes and exposing Lumière "Σ" plates to the radiations for 5 days. **B. Szilárd** (Ibid. 145. pp. 480–481, Sept. 2, 1907.)—Szilárd has repeated Lancien's experiments, and finds that the activity of the molybdate is not greater than that of the nitrate of uranyl; the activity is directly proportional to the uranium content of the salt. L. H. W.

1842. *Accumulation of Radio-active Substances in Corn.* **C. Acqua.** (Accad. Lincei, Atti, 16. pp. 857–860, Sept. 1, 1907.)—Contrary to Tarchanoff and Moldenhauer [Abstract No. 1864 (1906)], the author finds that wheat, barley, rye, and oats have no radio-activity either when cultivated in ordinary soil, or after germination in distilled water, or in a 0·2 per cent. solution of uranium nitrate. When grown in a 0·5 per cent. solution of thorium nitrate, on the other hand, the rate of discharge of an electroscope was increased from 5 to 20 volts per hour. W. H. Si.

1843. *Radio-activity of Rocks and Earths.* **G. Accolla.** (Accad. Gioenia, Boll. No. 92, Jan., 1907. N. Cimento, 13. pp. 444–449, May, 1907.)—The radio-activity of Etna lava, of the neighbouring rocks, and marine salts is negligible. More activity is shown by vegetable earths and surface clays. Tufa and basaltic detritus show more radio-activity than the rocks from which they originate. E. E. F.

REFERENCES.

1844. *On the Theory of the Rainbow.* **T. Tanakadate.** (Physico-Mathematical Soc., Tokyo, Proc. 4. 7. pp. 134–146, Aug., 1907.)—An extension of Airy's theory.

1845. *Optically Homogeneous and Turbid Media.* **L. Mandelstam.** (Ann. d. Physik, 23. 4. pp. 626–642, Aug. 22, 1907. Phys. Inst., Strassburg.)—A theoretical discussion of optical media in which particles occur whose dimensions are small in comparison with the wave-length. E. H. B.

1846. *Influence of Internal Reflection on Interference Phenomena in Doubly-refracting Crystals.* **H. Joachim.** (Gesell. Wiss. Göttingen, Nachr., Math.-Phys. Klasse, 3. pp. 321–340, 1907.)—Treats the above problem both mathematically and experimentally, polarised light being used and the spectrum of the emergent light studied. The paper is illustrated by curves and figures, and concludes with a table showing the relation of the phase-difference to internal reflection for mica leaf. E. H. B.

1847. *Elliptic Polarisation by Reflection.* **R. C. Maclaurin.** (Roy. Soc., Proc. Ser. A. 79. pp. 481–508, Sept. 6, 1907.)—A mathematical paper dealing with light elliptically polarised by reflection, especially near the polarising angle. The paper has particular reference to the reflections from diamond and realgar, and is illustrated by over a score of figures and curves showing the constants of the light reflected at different angles. [See also Abstracts Nos. 701 (1906) and 993 (1907).] E. H. B.

1848. *Optics of Moving Bodies.* **J. Laub.** (Ann. d. Physik, 23. 4. pp. 738–744, Aug. 22, 1907. Physikal. Inst., Würzburg, June 18, 1907.)—A mathematical treatment of the optics of moving bodies (including the Fizeau experiment and Doppler's principle) on the basis of Einstein's electrodynamics of moving bodies. E. H. B.

1849. *Coma in Uncorrected Lens Systems.* **F. Staeble.** (Zeitschr. Instrumentenk. 27. pp. 241–249, Aug., 1907.)—The author investigates analytically the connection between coma and the sine term in spherical uncorrected systems. C. P. B.

1850. *Temperature Emission of Iodine Vapour.* **R. W. Wood.** (Phys. Zeitschr. 8. pp. 517–518, Aug. 1, 1907. From the English.)—Another criticism of Fredenhagen's work, Reinganum's conclusion being supported. [See Abstracts Nos. 851 and 1343 (1907).] G. E. A.

1851. *Band Spectrum of "Effect" Carbons and of Barium Fluoride.* **J. Rösch.** (Zeitschr. Wiss. Phot. 4. pp. 384–393, 1906. Chem. Zentralblatt, 1. pp. 396–397, 1907. Abstract.)—Tabulated results of a photographic examination of the spectra of the fluorides of Ca, Ba, and Sr. The measurements are in agreement with Thiele's law, but not with that of Deslandres. L. H. W.

1852. *Spectra of Calcium and Magnesium as observed under different Conditions.* **W. N. Hartley.** (Roy. Dublin Soc., Proc. 11. 20. pp. 243–246, Aug., 1907.)—Some observations upon the variation of the character of the spark spectra of calcium and magnesium under different conditions. E. C. C. B.

1853. *Canal Rays in Hydrogen, Helium, and Argon.* **E. Dorn.** (Phys. Zeitschr. 8. pp. 589–590, Sept. 15, 1907. Physikal. Inst., Halle, Aug. 6, 1907.)—A preliminary communication giving a brief statement of results obtained on the Doppler-effect in these gases. R. S. W.

1854. *Some Properties of the Radium Atom.* **E. Riecke.** (Gesell. Wiss. Göttingen, Nachr., Math.-Phys. Klasse, 2. pp. 163–170, 1907.) R. S. W.

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1855. *Thermometric Device.* **P. Millet.** (Bull. Technolog. des Ecoles Nationales d'Arts et Métiers, pp. 436–445, June, 1907. Rev. Électrique, 8. p. 185, Sept. 30, 1907.)—This device utilises the rapid variation of the resistance of an electrolytic conductor with temperature. The resistances are measured by Kohlrausch's method, using a telephone and a Wheatstone bridge. The author indicates how his device can be employed to determine the temperature of a water-heater at a distance. The thermometer consists of a U-tube of thin Jena glass, containing a 60 per cent. solution of acetic acid, the resistivity of which at 18° C. is $4{\cdot}56 \times 10^{-4}$ megohms and the temperature coefficient 0·0206. The electrodes are of "platinised platinum," and the leads in the case described consist of two wires 0·6 mm. in diameter of ordinary insulation resistance and 300 m. long. The apparatus was standardised to read to 0·1° C. After 5 days the maximum inaccuracy was 0·2 of a degree and after 17 days 0·5 of a degree. If the resistances of the bridge coils alter with temperature a suitable correction has to be made. A. R.

1856. *Method of observing Melting-points of Metals.* **R. Loebe.** (Zeitschr. Elektrochem. 13. pp. 592–598, Aug. 30, 1907.)—The author welds a short wire of the metal whose melting-point is to be observed to the ends of two platinum wires, which are in circuit with an electromagnet sustaining a bell hammer. The wire is heated in a suitable chamber side by side with the thermo-couple, and the galvanometer is read the instant the bell is struck, the fusion of the wire breaking the electromagnet circuit. The wire may be 0·8 mm. diam. and 5 mm. long. The advantages of the arrangement over those used by Berthelot and by Holborn and Day are pointed out. F. R.

1857. *Specific Heats of Elements.* **R. Laemmel.** (Ann. d. Physik, 23. 1. pp. 61–72, May 28, 1907.)—The atomic heats of the solid elements range from 2 or 3 cals. at very low temperatures to 9 or 10 cals. at very high temperatures. For comparable temperatures they are sensibly equal. The author calls "comparable temperature" the actual temperature divided by the melting-point, both measured on the absolute scale. On recasting Dulong and Petit's law in this sense the anomalous positions of carbon, boron, and silicon disappear. New anomalies appear in the case of solid mercury and gallium, but these may be due to our very imperfect knowledge of their atomic heats. The relation $a\delta T =$ constant, between the coefficient of expansion a, the atomic volume δ, and the melting-point T is more correctly put $a\delta = B\theta/T$, where θ is the actual temperature [see also Abstract No. 1272 (1907)]. E. E. F.

1858. *Specific Heat of Nitrogen, Carbon Dioxide, and Water-vapour between 0° and 1,400° C.* **L. Holborn** and **F. Henning.** (Ann. d. Physik, 23. 5. pp. 809–845, Sept. 24, 1907. Communication from the Physikal.-Techn. Reichsanstalt.)—The observations formerly made on these substances [see Abstracts Nos. 765 (1905) and 828 (1906)] are here extended from 800° to 1,400° C., the former methods being again employed with only such modifications of apparatus as the heightened temperatures require. Linear formulæ were found to represent the connection between the temperature θ and the ratio of the mean specific heats between 110° and θ° of either CO_2 and N_2 or H_2O and N_2, and also between θ and the mean specific heat of nitrogen between 20° and θ. From these and the former results were finally deduced for atmospheric pressure—

$$C_{0,\theta} = 0{\cdot}2350 + 0{\cdot}000019\theta$$

for nitrogen—

$$C_{0,\theta} = 0{\cdot}2010 + 0{\cdot}0000742\theta - 0{\cdot}000000018\theta^2$$

for carbon dioxide, and—

$$C_{100,\theta} = 0{\cdot}4669 - 0{\cdot}0000168\theta + 0{\cdot}000000044\theta^2$$

for water vapour. For the last substance the observations are equally well represented by—

$$C_{100,\theta} = 0{\cdot}4544 + 0{\cdot}006925 \times 10^{0{\cdot}0007513\theta}.$$

R. E. B.

1859. *Heat of Evaporation of Water.* **A. W. Smith.** (Phys. Rev. 25. pp. 145–170, Sept., 1907.)—Dried air is sucked through water, causing evaporation, while an electric current supplies the heat necessary to prevent cooling. The amount of heat supplied is determined in joules and reduced to mean calories by the divisor 4·1887; the vapour produced is caught in H_2SO_4 drying tubes and weighed. It is thus found that within the range 14°–40° C. the heat of evaporation (in mean calories per gm.) is given by $L = 597{\cdot}44 - 0{\cdot}580t$. The method was found to be quite satisfactory for all temperatures at which the water-bath surrounding the calorimeter can be maintained without appreciable change, its great advantage being that no radiation-correction comes into account. Its results are in line with those of Dieterici at 0° C. and of Griffiths at higher temperatures. R. E. B.

1860. *Dependence on Temperature of the Thermal Conductivity of certain Gases and Vapours.* **E. Pauli.** (Ann. d. Physik, 23. 5. pp. 907–931, Sept. 24, 1907. Extract from Dissertation, Jena, 1907.)—A method due to Winkelmann is employed with improved apparatus with the vapours of alcohol, ether, carbon disulphide, water, ammonia, and ethylamine, and also with air and carbon dioxide. The rates of cooling of a thermometer in two vessels of different size containing the same vapour at the same pressure (which is low enough for convection effects to be negligible) are determined at about 15° when the walls of the containing vessels are kept at 0° C. and at about 115° with the walls at 100° C. It is assumed that the cooling-coefficient v at temperature t, which is the quotient of the rate of cooling at t by the excess of t above the temperature of the walls, is of the form $lf + r$, where f is a function of the shape and dimensions of the apparatus, r the rate of radiation, and l the conductivity-constant for the temperature t, and that the radiation-rate r is independent of the dimensions; also that l is of the form $l_0(1 + \gamma t)$: thus the two vessels give $\alpha \equiv v - v' = l(f - f')$ at temperature t and similarly $\beta \equiv V - V' = L(f - f')$ at temperature T, whence the temperature-coefficient γ is given by $(\beta - \alpha)/(\alpha T - \beta t)$. The values of $10^5\gamma$ found are—for air 197, CO_2 418, water 369, NH_3 439, CS_2 516, alcohol 576, ethylamine 611, ether 682. These results are in fair agreement with Winkelmann's when the latter are diminished as Winkelmann has shown they should be. Theory shows the conductivity to be proportional to the product of the viscosity and isometric specific heat, but the data at hand are not sufficient to test this result properly: such as we have are not in good agreement with it, but yet cannot be looked on as contradictory of the theory. R. E. B.

1861. *Radiation of Incandescent Mantles.* **Foix.** (Comptes Rendus, 145. pp. 461–468, Aug. 26, 1907.)—An analytical investigation of the emissive power of the substance of the Auer mantle. The radiation depends largely on the addition of a small quantity of cerium oxide to the thorium oxide. The result is reached that the luminous output may be increased either by diluting the oxide of cerium in the oxide of thorium or by reducing the thickness of the oxide of cerium. This is confirmed by experiment. J. J. S.

1862. *Carbon at High Temperatures and Pressures.* **C. A. Parsons.** (Roy. Soc., Proc. Ser. A. 79. pp. 532–535, Sept. 6, 1907.)—Attempts were made on two lines to melt carbon by passage of a current through it whilst under pressure. In the first, carbon was compressed to about 30 tons per sq. in. in a steel cylinder 8 in. diam., under currents of from 6,000 to 50,000 amps. The central portion of the carbon was in the form of rods, and these were partially converted to graphite and welded together. When the centre of the core was initially graphite the flakes became much larger. Heating was in all cases limited by the melting of the poles. The thermal conductivity of carbon or graphite at or near the temperature of vaporisation appeared much greater than was anticipated; the heat may, however, have been rapidly transferred by carbon vapour. The second method used was that of interposing an insulation of refractory material between the pole-pieces, which were also the pressure heads, the carbon charge being carried in a small hole through the centre of the insulator. Graphite was in this way made softer at its centre, and its flakes became larger. In none of the experiments was there found more than a suspicion of black or transparent diamond. In an experiment in which molten highly-carburised iron was submitted to 75 tons per sq. in. pressure, the sample was found to contain scarcely any crystalline residue on analysis, whence it is inferred that mechanical pressure is not the cause of the production of diamond in rapidly cooled cast-iron. F. R.

1863. *Adsorption of Gases by Charcoal.* **H. Baerwald.** (Ann. d. Physik, 23. 1. pp. 84–106, May 28, 1907. Extract of Dissertation, Freiburg.)—The capacity for condensing gases at the surface belongs mainly to porous bodies. An enormous increase of the adsorption at low temperatures is found in charcoal, but nowhere else. Palladium shows no increase of absorption when immersed in liquid air. The density of the gas and the carbon are the decisive factors in the adsorption of gases. Charcoal powder shows less adsorption than the solid material. The lighter the carbon, the more rapidly is the adsorption completed. Charcoal prepared from elder pith takes up nitrogen as easily as cocoanut charcoal absorbs hydrogen. Adsorption, as a rule, is most rapid in the lightest charcoal and for the lightest gases. As regards the initial state of the carbon, no complete elimination of the original gases is as yet feasible. Gases are given off on heating even beyond 500° C. All that can be done at present is to note the adsorption after maintaining the temperature for some time at any given point. There is a probability that all gases are adsorbed to the same extent at their boiling-points by the same kind of charcoal. The amount so adsorbed is 240 c.cm. in the case of cocoanut charcoal, and 300 c.cm. in the case of elder-pith charcoal. E. E. F.

1864. *Explosion-limits of Certain Gas Mixtures.* **N. Teclu.** (Journ. Prakt. Chemie, 75. pp. 212–228, 1907.)—The author has determined the upper and lower explosive limits of several combustible gases with air, using an apparatus described and illustrated in the original paper. The sensitiveness to explosion with air places the gases in the order: acetylene, methane, coal gas, hydrogen; the range of explosibility increases in the order: methane, coal gas, hydrogen, acetylene, and in the proportions: 1 : 4·21 : 12·7 : 18·5. With acetylene contraction takes place on explosion of mixtures containing less than 7·08 or more than 49·79 per cent.; expansion with mixtures between 7·08 and 41·92 per cent.; and without change of volume for the range 41·92 to 49·79 per cent. The following table shows the range of the mixtures capable of being exploded by an electric spark :—

	Explosion Limit in per cent.	
	Lower.	Upper.
Hydrogen	9·73–9·96	62·75–63·58
Coal gas	4·36–4·82	28·35–23·68
Methane (marsh gas)	8·20–3·67	7·46– 7·88
Acetylene	1·53–1·77	57·95–58·65

L. H. W.

1865. *Condensation of Vapours in Ionised Gases.* **K. Przibram.** (Phys. Zeitschr. 8. pp. 561–564, Sept. 1, 1907. Inst. f. Theoret. Physik, Wien.)—Experiments were made by the author on condensation according to the methods of C. T. R. Wilson and H. A. Wilson. He found that in the case of alcohol vapour, contrary to the behaviour of water vapour, condensation took place with smaller expansions on the positive ions, and then with greater expansions also on the negative ions. According to the observations with ethyl alcohol, the positive ions alone act as nuclei with expansions between 1·18 and 1·20. Experiments were made in an electric field, Röntgen rays being used to produce ionisation. In one series of observations the mean velocity of fall was 0·057 cm./sec.; the mean radius of drops or particles, $7{\cdot}7 \times 10^{-3}$ cm.; the mean mass of particles, $1{\cdot}4 \times 10^{-13}$ gm.; and the average charge $e = +8{\cdot}8 \times 10^{-10}$ E.S. units. Observations were also made with other vapours such as CS_2 in air and in hydrogen or CO_2. J. J. S.

1866. *Condensation Nuclei produced by Cooling.* **G. Owen** and **A. L. Hughes.** (Phil. Mag. 14. pp. 528–538, Oct., 1907.)—Air which was admitted into the cloud chamber of a Wilson's expansion apparatus after severe cooling was found to contain large numbers of nuclei, and dense showers were produced. Investigation showed that with all gases tried (except hydrogen) there is a more or less definite "critical temperature," below which each gas has to be cooled before the production of these nuclei can be detected. This "critical temperature" for air was —140° C. at a pressure of 101 cm. of mercury, —145° at 80 cm., and —160° at 41 cm. The air used was obtained from boiling liquid air. With ordinary air the results were the same. The "critical temperature" was not certainly determined for hydrogen, but is lower than that found for other gases. The value for oxygen is the same as that for air, and for nitrogen at 101 cm. the temperature was —125°, while at 41 cm. it was the same as for air. The following facts were observed in all the experiments: (1) After passing below the "critical temperature" the number of nuclei produced increases rapidly with the degree of cooling, the maximum effect occurring when some of the gas turns or is about to turn into the liquid state. (2) The number of nuclei produced is independent of the time of cooling, provided the time is long enough to allow the gas to fall to the temperature of the cooling liquid. (3) The nucle show a remarkable

persistency. (4) The number of nuclei "caught" is independent of the value of the expansion used. A small expansion of 1·10 was usually employed. While the origin of the nuclei produced by cooling to a low temperature is uncertain, it is suggested that the molecules of the gas may come together and form aggregations, or, in fact, that *incipient liquefaction* may occur.
J. J. S.

1867. *On the Work which may be gained during the Mixture of Gases.* **S. H. Burbury.** (Phil. Mag. 14. pp. 422–425, Sept., 1907.)—Rayleigh in the *Phil. Mag.* for 1875 (Ser. 4. vol. 49. p. 311) gives a proof of the law enunciated on p. 125 of Bryan's *Thermodynamics,* which the author has criticised [see Abstract No. 1544 (1907)]. The author states the problem as follows: In a horizontal tube is a mixture of two gases, say oxygen and hydrogen, the pressure of the combined gases, and also the temperature being uniform throughout the tube. Consistently with these conditions the gases may be (1) mixed in the same relative proportions at all points in the tube, or (2) wholly or partially separated, oxygen being in greater relative density towards one end, hydrogen towards the other. Rayleigh and Bryan maintain that to bring the mixture from state (1) to state (2) work would have on the whole to be spent, but the author gives reasons for thinking otherwise. He also contends that in a complete cycle of operations, under the given restrictions, no work is done. The author claims that there is nothing in his assertion inconsistent with Rayleigh's proof—a *résumé* of which he gives. [See also Nature, 76. pp. 637–638, Oct. 24, for further discussion.] A. R.

REFERENCES.

1868. *Coefficient of Linear Expansion at Low Temperatures.* **H. G. Dorsey.** (Phys. Rev. 25. pp. 88–102, Aug., 1907.)—An account of an elaborate series of measurements of the coefficients of linear expansion of various solids, chiefly metals—antimony, cadmium, bismuth, copper, glass, gold, iron, platinum, silver, soft solder, tin, and quartz glass—by Fizeau's method as modified by Ayers [see Abstract No. 548 (1905)]. J. J. S.

1869. *Conductivity for Heat and Thomson-effect.* **J. Radakovits.** (Phys. Zeitschr. 8. p. 505, Aug. 1, 1907.)—A note discussing the possible relation of the conductivity for heat and the Thomson-effect in the case of various metals and alloys. No general approximation formula can be given expressing a connection between these two constants. J. J. S.

1870. *Optical Pyrometry.* **L. Holborn.** (Engineering, 84. pp. 345–347, Sept. 6, 1907. Electrician, 59. p. 794, Aug. 30, 1907. Abstract of paper read before the British Assoc. at Leicester.)

1871. *Properties of Substances with Characteristic $pv = Rt$.* **R. Laemmel.** (Ann. d. Physik, 23. 3. pp. 591–593, July 5, 1907.)—A criticism of Adler's paper [see Abstract No. 861 (1907)] showing that its main contentions are wrong; but he seems to justify Adler's invention of an unmeaning specific heat at constant internal pressure. **F. W. Adler.** (Ibid. pp. 975–978, Sept. 24.)—A reply. R. E. B.

1872. *Joule-Thomson Effect.* **E. Buckingham.** (Nature, 76. p. 493, Sept. 12, 1907.)—Attention is drawn to Regnault's experiments (in 1870) on the flow of gases through porous bodies, &c., which were on the whole unsatisfactory, though the most definite numerical results obtained were not very different from those found by Joule and Kelvin (in 1852–4). R. E. B.

SOUND.

1873. *Passage of Sound through Narrow Slits.* **Rayleigh.** (Phil. Mag. **14.** pp. 153–161, July, 1907.)—Theory leads to the curious conclusion that plane waves of sound incident upon a parallel, infinitely thin reflecting screen which is perforated by a narrow slit, are transmitted in a degree depending but little upon the width of the slit. This conclusion is here tested experimentally, the difficulties in the way, however, turning out to be more considerable than anticipated, and a number of different arrangements as to source and other details were in succession tried. The best results finally obtained showed that, for the sound *f*, a change of the length of the slit from 0·5 to 0·28 in. compensated a change in the width either from 0·002 to 0·010 in., or from 0·004 to 0·020 in. Hence, as theory predicted, the sound is much less sensitive to an alteration of width than to one of length. E. H. B.

1874. *Tuning-fork Vibrations and Decrement.* **H. J. L. Struycken.** (Ann. d. Physik, **23.** 4. pp. 643–654, Aug. 22, 1907.)—Discusses the positions of nodes for the various partial tones and the dependence of these positions on the proportions of the fork. It is shown that the damping factor for a given fork is least when the stem is held between the fingers (or carefully fixed in a rubber ring), the prongs being downwards. E. H. B.

1875. *Scattering of Sound by Spheroids and Discs.* **J. W. Nicholson.** (Phil. Mag. **14.** pp. 364–377, Sept., 1907.)—When a plane train of sound waves falls upon a small spheroid or disc, formulæ expressing the scattering effect have been given by Rayleigh, who employed a method based on an analogy with potential theory. The formulæ are first approximations, holding only when the ratio of linear dimensions to wave-length is very small. The deduction of more accurate expressions requires the use of harmonic analysis, which has been given by Rayleigh for the case of the sphere. The present paper develops a suitable harmonic analysis for treating obstacles of other than spherical shape, and applies it to (1) a prolate spheroid of small ellipticity, (2) a long thin blade, (3) an oblate spheroid, (4) an approximately spherical planetary body, and (5) a circular disc. The methods and results are unsuitable for detailed abstraction. E. H. B.

REFERENCES.

1876. *Transverse Vibrations of Wooden Plates.* **T. Terada.** (Physico-Mathematical Soc., Tokyo, Proc. **4.** 6. pp. 122–125, July, 1907.)—Following up the experiments of Savart and theory of Wheatstone, the present author obtains Chladni figures with a number of circular plates of magnolia and spruce wood. And all these figures are imitated by those on elliptical plates of brass. E. H. B.

1877. *Vibrations of Membranes.* **W. Voigt.** (Gesell. Wiss. Göttingen, Nachr., Math.-Phys. Klasse, 2. pp. 171–176, and 3. pp. 341–364, 1907.)—Mathematical papers treating the vibrations of membranes in which either (1) part of the margin is free (*e.g.*, a central hole in a circular membrane held at its outer circumference) or (2) the tensions are unequally distributed. E. H. B.

ELECTRICITY AND MAGNETISM.

THEORY, ELECTROSTATICS, AND ATMOSPHERIC ELECTRICITY.

1878. *Inconstant Motion of an Electron.* **C. W. Oseen.** (Ark. för Mat. Astron. och Fysik, Stockholm, 3. 14. pp. 1–27, 1907.)—A sudden change of speed or acceleration produces a wave in the electromagnetic field. The author inquires as to whether this wave is capable of producing new discontinuities in the speed or acceleration of the electron. In previous studies it has always been supposed that the speed before the shock was constant. The present investigation deals mathematically with the rectilinear rotationless motions below or above the velocity of light. In general, no new discontinuities are produced. E. E. F.

1879. *Translation of Deformable Electrons.* **P. Ehrenfest, A. Einstein.** (Ann. d. Physik, 23. 1. pp. 204–205, and pp. 206–208, May 28, 1907.)—Ehrenfest brings forward a difficulty inherent in the deformable electron and not in Abraham's rigid spherical electron. If a rigid ellipsoidal electron is to move uniformly in any direction, the turning couple exerted upon it by its own charge in motion must be compensated. The same rule applies to a deformable electron of non-ellipsoidal shape, as postulated by Planck. This would undergo Lorentz's construction, and would indicate absolute motion, which is against the relativity principle. In reply to the foregoing, Einstein denies that the relativity principle involves a self-contained system. It only contains assertions concerning rigid bodies, clocks, and light signals. But it enables one to determine the laws of motion of an electron without recourse to electrodynamics, which assume the kinetics of rigid bodies as known. As a matter of fact, the kinetics of rigid bodies are very imperfectly known. We have only kinematics of parallel translation, and an expression for the kinetic energy involved in it. E. E. F.

1880. *Electromagnetic Mass of an Electron.* **F. Pockels.** (Phys. Zeitschr. 8. pp. 393–395, June 15, 1907.)—Replies to Righi's criticism [Abstract No. 446 (1907)] of Abraham's rigid electron having a uniform surface or volume charge. Abraham's assumption might be formulated thus: "The electron is an unchanging spherical region in the ether within which the divergence of electrification possesses a constant value different from zero." This would be less graphic than Abraham's formulation, but would meet Righi's objection. Instead of postulating a "limit of elasticity" in the ether, it might be better to assume a limiting value of the density of energy in the ether, which would correspond to the limit of Hertzian stresses. The recalculation of the electromagnetic mass in accordance with such an assumption is of doubtful benefit so long as the agreement between Kaufmann's results and Abraham's theory is not notably surpassed. E. E. F.

1881. *Energy radiated by Positive Ions.* **W. Wien.** (Ann. d. Physik, 23. 3. pp. 415–438, July 5, 1907. Physikal. Inst., Würzburg, May, 1907.)—In thermodynamic theories of radiation the distinction has always been emphasised between heat radiation and other forms of radiation. Such distinction is called for in the case of microscopic events like electric oscillations, to which no finite entropy can be assigned. But it is an open question whether non-thermal radiations due to molecular or atomic processes must necessarily be distinguished from thermal radiation. A question arises whether, for instance, the entropy of vacuum-tube radiation is completely determined by its intensity and wave-length. The author assumes an answer in the affirmative, and proceeds to develop the consequences. To obtain a gaseous mass in real thermal equilibrium, radiating as much energy as it absorbs, he considers the case of canal rays after they have entered a "black" enclosure where no further electric energy is communicated to them. He then applies Planck's theory of the entropy of radiation, in which the energy is distributed irregularly over a large number of centres of radiation. Applying the theory to the line H_β as displaced by the Doppler-effect discovered by Stark, the author finds the temperature of the radiation to be 4,584°. Calculating the mean velocity corresponding to this temperature in the case of a perfect gas whose atoms have the mass of an electron, this is $4{\cdot}61 \times 10^7$ cm. per sec., or the speed acquired by an electron in falling through 0·64 volt. The kinetic energy of the electron is then $9{\cdot}24 \times 10^{-13}$ erg, which is in fair agreement with Planck's elementary quantity of energy, 4×10^{-12} erg. If further experiments show a closer agreement, it will follow that the temperature is really determined by the mean kinetic energy of the electrons, and that the free electrons enter into dynamic equilibrium with those bound up with atoms. This facilitates a constant exchange of free and bound electrons. The kinetic energy of the free electron reappears as radiant energy so soon as it links up with the atom. The essential requisite for luminosity will therefore be the existence of the necessary kinetic energy of free electrons. The reasoning supposes that the number of ions is correctly determinable by the canal rays. E. E. F.

1882. *Relation between Resistance of Polarisation Circuit, Thickness and Distance Apart of Plates of Influence Machines.* **H. Wommelsdorf.** (Ann. d. Physik, 23. 4. pp. 601–608, Aug. 22, 1907.)—After reviewing the work of previous papers [see Abstracts Nos. 174, 798, and 1027 (1905)] the author gives the following conclusions: (1) The influence machine has for each discharge potential a most favourable thickness of plate, distance apart of plates, and resistance of polarisation circuit. (2) The best thickness of plates, distance apart of plates and—in double rotation machines—resistance of polarisation circuit, increase with the discharge potential in the working circuit. (3) With constant discharge potential and resistance in polarisation circuit, the best distance apart of plates increases with decreasing thickness of plates, and *vice versâ*. (4) In double rotation machines the best resistance of polarisation circuit increases with decreasing thickness and distance apart of plates, and *vice versâ*. (5) The best distance apart and thickness of plates (1) and the interdependence of these magnitudes (3) and (4) increase with the so-called "destructive discharge" at the back of the plates, and are in general less sharply defined in machines with fixed field than with those of double rotation, and when the plates work in a medium of greater dielectric strength than air. S. G. S.

1883. *Production of Statical Electricity by Heat and Light.* **G. Melander.** (Phil. Mag. 14. pp. 450–455, Oct., 1907.)—When bodies are exposed to sunlight they acquire an electrostatic charge, the sign of which varies with the nature of the body. The active rays are not stopped by a glass window, nor is the charge caused by air currents. The negative charge of the earth appears to be due to the direct action of sunlight. Electrification by friction may be explained as due to bodies possessing an electron temperature which is different from the ordinary molecular temperature. By rubbing two bodies together, the one with the lower electron temperature becomes negatively charged. R. S. W.

1884. *Radio-activity of the Air on the Open Sea.* **C. Runge.** (Gesell. Wiss. Göttingen, Nachr., Math.-Phys. Klasse, 2. pp. 211–229, 1907.)—On the journey from Hamburg to Algiers in the summer of 1905 the author stretched a copper wire, 18 m. in length, between the mast and the bridge, charged it up to several thousand volts from the negative pole of a Zamboni battery, and made his measurements with Gerdien's apparatus. The electroscope observations were difficult on board. The radio-activity was much stronger off the Thames and off the Morocco coast than in the Bay of Biscay. The observed effect could not wholly be due to radium emanation, nor to thorium, while tests made at the Hainberg, near Göttingen, can fully be explained by the action of radium and of thorium. Comparison experiments were also conducted in the Technical Hochschule at Hanover, which is infected with radium. H. B.

1885. *Ionisation of Air by Bubbling.* **L. Bloch.** (Comptes Rendus, 145. pp. 54–55, July 1, 1907.)—Ionisation by bubbling is greatly affected by temperature and by dilution. In the case of pure water a cooling from 13° down to 6° brings about a notable diminution of ionisation and a slight increase of average mobilities, together with a different distribution of the latter among the positive and negative ions. In pure water the negative ions are much the more numerous and mobile. On gradually adding sulphuric acid the mobilities of positive and negative ions tend towards equality. Their relative numbers do the same, while their absolute numbers diminish. When the proportion of acid is 0·00076 the two kinds of ions are equally numerous. When the acid further increases, positive ions begin to predominate. Hydrochloric acid behaves in a similar manner, except that the neutral point is reached at an 1/80 normal concentration, and the mobilities are generally higher. (Ibid. p. 317, July 29.) A criticism of de Broglie's paper [Abstract No. 1668 (1907)]. E. E. F.

1886. *Unipolarity of Atmospheric Electric Dispersion.* **K. W. F. Kohlrausch.** (Phys. Zeitschr. 8. pp. 656–658, Oct. 1, 1907. Physikal. Inst. d. Univ., Wien, June, 1907.)—Kurz has explained the unipolarity observed with measurements of atmospheric electric dispersion by attributing it to the effect of radio-active induction [see Abstract No. 2059 (1906)]. The author has undertaken experiments with the apparatus of Gerdien, Ebert, and Elster and Geitel. With Gerdien's apparatus air was drawn through at the rate of 0·06 m.^{3} per sec., and a value was found for M, the induction strength of the radio-active matter deposited in 5 min., of $1{\cdot}8 \times 10^{-4}$ static units, which corresponds to a loss of potential from the electroscope used of 0·2 volt per min. With 1,000 ions per m.^{3} of air the potential fall is about 20 volts per min.; so that on the average the induction effect is only 1 per cent. of the dispersion effect. With Ebert's apparatus, in which air was drawn through at the rate of 0·0017 m.^{3} per sec., the value of M for a 15-min. aspiration was $1{\cdot}2 \times 10^{-5}$ static units, which corresponds to a potential loss of 0·012 volt per min., which gives a much smaller ratio than with the Gerdien apparatus. With Elster and Geitel's apparatus such calculations could not be made. Also, if the induction strength of the deposit was sufficiently great to affect the dispersion value much, only with apparatus No. 3, and not with Nos. 1 and 2, could such effect be noticed. The research with No. 3 was made in such a way that the dispersion, and afterwards the induction effect, could be measured on the same apparatus. The author found that the ratio q of the dispersion for a negative charge to that for a positive charge varied from 1·3 to 2·4, and the difference between the two dispersions could not be attributed to observation errors. From all the results obtained it appears that the induction effect is very feeble, and the induction strength per $m.^3$ of air would have to be impossibly high to explain the unipolarity of dispersion. The author, moreover, working with a Gerdien and also with an Elster and Geitel apparatus, failed to find the effect recorded by Kurz. A. W.

DISCHARGE AND OSCILLATIONS.

1887. *Absorption of Gases by the Glass Walls of Vacuum Tubes.* **A. A. Campbell Swinton.** (Roy. Soc., Proc. Ser. A. 79. pp. 134–137, April 24, 1907. Chem. News, 95. pp. 134–136, March 22, 1907. Electrician, 59. pp. 603–604, July 26, 1907. Abstract.)—It is known that the vacuum gradually gets higher in Röntgen tubes that are constantly in use. The glass of such tubes has now been examined microscopically. The surface is found to be roughened. When portions are heated in a blow-pipe flame they become clouded; this is due to minute bubbles of gas, of average diam. 0·01 mm., packed closely together in a single layer at a depth of about 0·12 mm. The question arises whether the gas is merely mechanically mixed with the glass or chemically combined. Some of the glass is placed in a narrow metal chamber which is then highly exhausted; the metal chamber is placed on an anvil and the glass powdered. By examining the discharge in a spectrum tube which is sealed on to the chamber, it is found that gas is evolved, mainly hydrogen. This, the author supposes, comes from the electrolysis of water vapour condensed on the walls prior to exhaustion. These experiments support the view that the gas is mechanically held by the glass. Further evidence in this direction is found from the fact that helium, which is not known to combine chemically at ordinary temperatures, is occluded in a similar manner, and may be released by powdering the glass. R. S. W.

1888. *Gas Discharges.* **P. Villard.** (Comptes Rendus, 144. pp. 1261–1264, June 10, 1907.)—Describes the two chief forms presented by a vacuum discharge, and shows how one passes into the other by raising the voltage of the condenser discharged through the tube. Thus, in a non-inductive circuit, with a condenser p.d. of 2,500 volts, the positive light extends as far as the kathode in 1/200th sec., suppresses the negative layer, and completely discharges the condenser. At 3,000 volts the duration of the discharge becomes inappreciable, and the speed of the positive column immeasurable. There are strong inductive impulses. For feeble intensities and pressures such that the negative glow does not fill up the tube, the discharge consists of three distinct parts: (1) The positive light, a true conductor, whose kathodic extremity is constantly disintegrated by the shock of electrons, and in which all intense ionisation produces a dark space. (2) Faraday's dark space, produced by kathode rays, and transporting electricity purely by convection.

(8) The kathode rays. At a certain voltage the positive light is able to overcome the kathode ionisation, and cancels Faraday's dark space. Then there is, as in the arc, no kathode-fall, and oscillations may set in. In a Crookes tube it is the positive light that is suppressed. E. E. F.

1889. *Absorption of Hydrogen by Metals.* **W. Heald.** (Phys. Zeitschr. 8. pp. 659–662, Oct. 1, 1907. Translation from the English.)—Skinner has found [see Abstract No. 1768 (1905)] that most metals, when used as the kathode in a discharge tube, give off hydrogen. This shows that metals in their natural condition contain a certain amount of absorbed hydrogen. In the research undertaken by the author the discharge tube used was cylindrical, the electrodes being screwed or riveted on to the ends of brass rods which were cemented in glass tubes ground into the ends of the discharge tube. The latter was connected up to a pump through a drying tube, and also could be connected to a flask containing dry hydrogen. Before filling with hydrogen the tube was left for some time exhausted and in connection with the P_2O_5 tube. For fusing the metals a current from a battery of small accumulators was used, the voltage being about 1,000 volts. The tube was filled with hydrogen at a pressure of 1 to 6 mm. and then the current sent through to heat the electrodes. The pressure was measured by means of a sensitive McLeod manometer. The metals were heated up to fusion and afterwards time readings of the pressure were taken, the fall in pressure being due to absorption of hydrogen by the metals. The metals experimented on were Cd, Ag, Zn, steel, Al, and Pt; of these Cd, Ag, and steel give results which indicate slow absorption. In the case of Al and Pt, the pressure rose after the heating; it is probable that for these metals the absorption is so rapid that the metals are saturated before the pressure can be observed. Zinc is the only one of the metals investigated which shows no absorption. Tables and diagrams are given of the results, for which see original paper. A. W.

1890. *Rays of Positive Electricity.* **J. J. Thomson.** (Phil. Mag. 14. pp. 359–364, Sept., 1907.)—The rays of positive electricity consist mainly of streams of two kinds of positively charged particles, the value of e/m for one stream being 10^4 and for the other 5×10^3 [see Abstract No. 1069 (1907)]. These being the values of e/m for charged atoms and molecules of hydrogen direct measurements were made to test whether the positive rays were dependent on the presence of hydrogen in the discharge tube. The method adopted was to measure photometrically the brightness of the phosphorescent patches produced by the rays on a screen covered with willemite. It was found that whether the discharge tube was filled with oxygen or with hydrogen the intensity of the phosphorescent patch was the same, the currents through the tube being kept equal in each case. There is thus no indication that the positive rays are dependent upon the presence of hydrogen in the tube. These positive rays are to be found distributed throughout the tube and can be detected in all parts which have an uninterrupted view of the ordinary canal rays or of that luminous patch next the kathode, of which the canal rays are the prolongations. Positive rays are found in front of the kathode and travelling away from it. The existence of these might be explained by a kind of reflection of those travelling towards the kathode, or the gas traversed by the positive particles moving rapidly towards the kathode may be regarded as being thrown into a condition analogous to that of a radio-active substance and shooting out with great velocity electrified particles, corresponding to α- and β-particles. On the latter explanation the positive particles might be expected to be shot out in all directions, while on the former they would tend to follow the lines of force in the tube and be mainly right in front of the kathode. An experiment is described in which their behaviour in this respect was tested. It was found that particles of positive electricity are shot off in all directions from the gas traversed by the canal rays. [See also Abstract No. 1669 (1907).] J. J. S.

1891. *Photo-electric Activity as a Resonance Effect.* **E. Ladenburg.** (Phys. Zeitschr. 8. pp. 590–594, Sept. 15, 1907. Physikal. Inst. d. Univ., Berlin, Aug., 1907.)—If the discharge of electricity from metals caused by ultraviolet light is due to resonance, then it is of interest to measure the velocity of the emitted electrons, using light of different wave-lengths. Light from a mercury vapour lamp is passed through a spectrometer containing quartz-fluorspar achromatic lenses and a fluorspar prism, and then falls on a narrow strip of metal suitably insulated and screened. The initial velocities of the electrons are found by raising the potential of the plate just high enough to stop the leak; the velocities are proportional to the square root of this potential. Tables are given showing, for Cu, Pt, Zn, that with decreasing wave-length of light the velocity of the emitted electrons increases. The ratio of the frequency of the waves to the velocity is constant. The more electro-positive the metal the smaller the velocity of its electrons. Viewing the matter as a resonance effect we can now obtain the relative numbers of the electrons in the metal moving with the different velocities, if we find the number emitted for equal light intensities, provided we know how the discharge varies with the wave-length alone. The latter is investigated as follows. The vapour lamp gives a very regular discharge, and so the energy for given wave-lengths is measured by a thermopile, and afterwards the quantity of electricity discharged, by means of a galvanometer. For the above three metals the photo-electric effect is a maximum for a wave-length 212–218 $\mu\mu$; for equal light-intensities it rises continuously as the wave-length is decreased. R. S. W.

1892. *The Ruhmkorff Coil.* **O. M. Corbino.** (Atti dell' Assoc. Elettr. Ital. 11. pp. 268–325, July–Aug., 1907.)—The effects produced on closing and on opening the primary circuit are studied separately. In the former case, equations for the primary and secondary currents, and for the total and secondary fluxes, are obtained, and these show that the phenomena occur in two phases: in the first the primary and secondary currents, which are in opposite directions, fall exponentially and rapidly, the total magnetic flux associated with the secondary being zero; in the second phase the three variations are exponential and much slower than those of the first phase, the primary current and the flux approaching a final steady value and the secondary current approaching zero. Also the curve obtained by plotting secondary current as abscissa and flux as ordinate is a straight line cutting both axes on the positive side of the origin. The experiments are made with a Braun tube so arranged that the displacements may be proportional to any two of the quantities, primary current, secondary current, and flux. The theoretical results are completely confirmed, and it is also shown that the exponential fall of secondary current found when the circuit is metallically closed becomes a linear fall when the circuit contains an air-gap. In the second part the effect of opening the primary is dealt with. The differential equations for the circuits are solved by means of a geometrical treatment.

The experimental results follow. The behaviour is so complicated in this case that the work cannot be conveniently abstracted, but it may be noted that there are two phases in the secondary discharge, the first being oscillatory and rapidly damped, the second being linear; and that the current is in all cases unilateral, the relative lengths of the two phases depending upon the length of the spark. It is also shown that there is a "best" value for the capacity in the primary circuit. The paper closes with an account of some similar experiments made with the Wehnelt interrupter. S. G. S.

1893. *Graphic Representation of Formulæ for Electric Oscillations.* **M. La Rosa.** (N. Cimento, 13. pp. 390–400, May, 1907.)—If in the formula, $T = 2\pi\sqrt{(4L^2C)/(4L - R^2C)}$, $x = L$, and $y = T^2/4\pi^2$, we get the equation, $4Cx^2 - 4xy + R^2Cy = 0$, which represents an hyperbola, with centre at $x_0 = R^2C/4$, $y_0 = R^2C^2/2$. The author indicates convenient methods of plotting this and similar equations involving period, inductance, capacity, and resistance in oscillating circuits. E. E. F.

1894. *Hertzian Gratings and Conductivity.* **C. Schaefer** and **M. Laugwitz.** (Ann. d. Physik, 23. 5. pp. 951–956, Sept. 24, 1907. Physikal. Inst. d. Univ., Breslau, July, 1907.)—This paper deals with the dependence of the behaviour of gratings upon the conductivity of their wires when used for Hertzian waves. Wires of four different materials were used, and the final results were in good agreement with Maxwell's theory, as shown in the following table:— [Note constancy of numbers in last column.]

Material of Wires.	Observed Reflection (R).	Observed Transmission (T).	Absorption (A) = (100 − R − T).	$A/\sqrt{\omega}$; ω = Resistance of 1 m. of Wire.
	Per Cent.	Per Cent.	Per Cent.	
Silver	35·5	62·1	2·4	0·38
Platinum	32·9	60·6	6·5	0·39
Manganin	32·0	57·7	10·3	0·38
Kruppin	25·0	55·8	18·9	0·46

E. H. B.

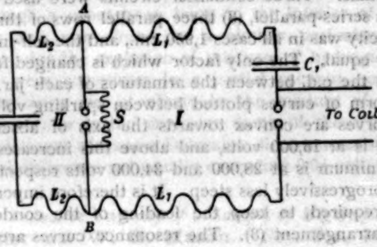
1895. *Analysis of Electrical Oscillations with the aid of the Kathode-glow Oscillograph.* **H. Diesselhorst.** (Deutsch. Phys. Gesell., Verh. 9. 14. pp. 318–320, July 30, 1907. Communication from the Physikal.-Techn. Reichsanstalt.)—A preliminary account of means whereby the use of Gehrcke's oscillograph can be extended to higher frequencies than 5,000 per sec. [Abstract No. 2100 (1905)]. Photographing with a *concave* revolving mirror of 10 cm. diam. and 15 cm. focus, the mirror making 114 revs. per sec., an oscillation of wave-length 440 m., corresponding to a frequency of 680,000 per sec., was distinctly visible on the plate; the curve of the separate periods was not obtained, since the length representing 1 period on the plate was only 0·46 mm. What could be observed was the course of curve, and in this way a means of controlling ordinary methods of measuring the damping is provided. With a frequency of 11,000 per sec. (27 mm. per period on plate) the nearly sine-shaped nature of the curve for a single period is readily seen. The effect of close coupling in giving rise to two sets of oscillations is also well illustrated by this means. A fuller account is to appear later on.

L. H. W.

1896. *The Thermophone Principle and the Production of Continuous Oscillations.* **F. Weinberg.** (Elektrotechn. Zeitschr. 28. pp. 944–945, Sept. 26, 1907.)—The author traces the evolution of the so-called thermophone, and endeavours to apply it to the production of continuous oscillations. These experiments led him to try if a glow-lamp would not serve as thermophonic device for this purpose, but without result, owing to the vacuum. A Nernst glower was found to give the best results. Such a thorium [thoria ?] rod, when affected by a microphone current, can be employed as transmitter in light-telephony. It can also be used, with a Duddell circuit in place of the arc, as a producer of electrical oscillations. The only experiments made appear, however, to consist in placing the Nernst glower in a hydrogen atmosphere : the disappearance of the whistling sound of the arc is taken as showing that the frequency is raised to above the limit of audition [?]. **J. Sahulka.** (Ibid. pp. 1088–1089, Oct. 24, 1907.)—Using a 200-volt Nernst glower in a Duddell circuit in place of the arc, the author heated the glower with a gas flame and supplied it with current at 220 volts. It was not, however, found possible to set up oscillations in the shunt circuit.

L. H. W.

1897. *Charging of Condensers by High-frequency Currents.* **A. Jollos.** (Ann. d. Physik, 23. 4. pp. 719–787, Aug. 22, 1907. Extract from Inaug.-Dissertation, Strasburg.)—The author describes a method of charging up condensers by means of high-frequency currents, which is considered to obviate the energy losses that occur during the charging process in the known methods which make use of such currents for charging purposes (Fleming, v. Czudnochowski). The arrangement employed by Mandelstam and Papalexi for producing phase-displaced oscillations is adopted [Abstract No. 1277 (1906)], and is shown in the Fig. Here C_1, C_2 are capacities, L_1, L_2 self-inductances, S is a very high resistance or large self-inductance. C_1 is charged by the slow oscillations of the induction coil secondary, through S, and discharges itself in the form of rapid oscillations through the circuit composed of L_1, L_2, and C_2. In this way C_2 is charged by high-frequency oscillations at the expense of C_1. If now between two suitable points, A and B of the circuit, a second spark-gap be included, and so arranged that a spark only passes when the *whole charge* of C_1 has gone over to C_2, a return of the charge to C_1 is prevented, and further oscillations take place only within the circuit AC_2B, comprising the capacity C_2 and self-inductance L_2. A lengthy theoretical examination of the arrangement follows, and then an experimental part. From these the following conclusions can be drawn : (1) The arrangement works so efficiently that it should be employed from



preference for the charging of condenser circuits. (2) Theory and experiment lead to the result that in this way it is possible to discharge a condenser circuit through a *shorter spark-gap* than corresponds to the condenser p.d. Compared to the ordinary slowly-charged condenser circuit, the same p.d. at the condenser with the same current amplitude and energy can be here combined with only half the voltage at the spark-gap. (3) Investigation of this last condition (high-frequency charging with smallest possible spark-gap) shows, as compared with slow charging and equal energy, a 20 per cent. higher integral effect and a nearly corresponding decrease of the damping. (4) By this arrangement it has now become possible to submit the effect of current strength and of spark-length on the damping, and hence on the spark resistance, to investigation *separately*. For small spark-lengths there is a slow increase of resistance with spark-length and a much steeper decrease with increasing current; this explains Rempp's results, in which decreased damping with increase of spark-length was noticed. (5) For longer sparks, independently of the method of charging, the departure of the resonance curves from the form required by Bjerknes' theory is explained as being due to the "brushing" of the condensers. L. H. W.

1898. *Brush Discharges at Condenser Edges.* **W. Eickhoff.** (Phys. Zeitschr. 8. pp. 564–569, Sept. 1, 1907. Physikal. Inst. d. techn. Hochschule, Braunschweig, June, 1907.)—A quantitative investigation of the losses due to the well-known "brushing" (Sprühen) of condensers when these are worked at high potentials. Three condenser circuits were used: (1) a single jar, (2) four jars in series-parallel, (3) three parallel rows of three in series. The resultant capacity was in all cases 1,950 cm., and the self-inductance was also approximately equal. The only factor which is changed for the same spark-length is thus the p.d. between the armatures of each jar. The results are given in the form of curves plotted between sparking voltage and damping (δ). These curves are convex towards the axis of abscissæ. For (1) the minimum of δ is at 18,000 volts, and above this increases rapidly. For (2) and (3) the minimum is at 28,000 and 34,000 volts respectively, and the rise afterwards is progressively less steep. It is therefore important, where sharp resonance is required, to keep the loading of the condensers low, as by adopting the arrangement (3). The resonance curves are found to be unsymmetrical and the resonance point is shifted (always towards lower frequencies) when strong "brushing" across the dielectric occurs. This behaviour is attributed to the fact that such "brushing" makes the dielectric partially conducting, and has as its result the same effect as if the condenser coatings were increased in size, by a variable amount; hence the variable change in frequency. Since the resonance changes also with increasing spark-length, the tuning in wireless telegraph stations should be effected at the spark-length which is to be employed. On immersing the condenser in oil the anomalous behaviour is no longer observed. The results are a further argument in favour of condensers of diameter small compared to the length. [See also Jollos, preceding Abstract.] L. H. W.

1899. *Study of the Barretter.* **K. E. F. Schmidt.** (Phys. Zeitschr. 8. pp. 601–606, Sept. 15, 1907. Physikal. Inst., Halle, July, 1907.)—The author describes a convenient arrangement for employing the wire barrettor of Fessenden in the measurement of high-frequency oscillations. Greater constancy of the oscillations is said to be obtained by passing the spark in a hydrogen atmosphere. The construction is described and curves given of barretters of different sensibilities. The total resistance of the bridge arrangement should be as small as possible; the ratio of division is unimportant. L. H. W.

ELECTRICAL PROPERTIES AND INSTRUMENTS.

1900. *Magnetic Field due to a Current-bearing Wire.* **W. J. Humphreys.** (Science, 26. pp. 417–418, Sept. 27, 1907.)—Gives a new derivation of the electrodynamic law based upon the assumption that "the field due to each electron is influenced by all others, and so influenced that it is confined to a plane at right angles to the wire, but equal in every direction from it."

E. E. F.

1901. *Unipolar Induction.* **A. Szarvassi.** (Ann. d. Physik, 23. 1. pp. 73–83, May 23, 1907. Phys. Inst. d. techn. Hochschule, Brünn, Feb. 22, 1907.) —Deals with the theory of the current produced in a wire when one end of it is in contact with the end of the axis of a cylindrical magnet rotating about that axis, while the other end is in contact with the curved surface of the cylinder. The author localises the curl of electric force at the surface of the rotating magnet, where there is a discontinuity of speed. E. E. F.

1902. *Electric Phenomenon presented by Platinum.* **De Muynck.** (Annal. Soc. Sci. de Bruxelles, 31. 3. pp. 282–285, 1906–1907.)—Two platinum wires passed through a caoutchouc bung to the interior of an aluminium vessel whose far end was closed by a similar perforated bung. The apparatus was used for the explosion of mixtures of hydrogen and oxygen; hence the wires were sometimes in a partial vacuum, sometimes in an atmosphere of ordinary air, at others in the mixture of hydrogen and oxygen (rich in ozone), or in the explosive flame of these gases. On connecting the two platinum wires to a Dolezalek electrometer they were found to have a potential difference not usually exceeding 0·04 volt. E. H. B.

1903. *Specific Inductive Capacity of a Sample of Highly-purified Selenium.* **O. U. Vonwiller** and **W. H. Mason.** (Roy. Soc., Proc. Ser. A. 79. pp. 175–181, May 14, 1907.)—Determinations of the specific inductive capacity were made (*a*) by the absolute electrometer method with alternating currents having a frequency of about 50 per sec.; K was found equal to 6·18 at an average temperature of 16° C.; (*b*) by a method using electric oscillations with a frequency of 24×10^6 per sec.; K was found equal to 6·14 at an average temperature of 28·6° C. The specific resistance of the selenium used was (in the dark) $2{\cdot}2 \times 10^{16}$ ohms at 20° and $6{\cdot}5 \times 10^{15}$ ohms at 25° C.

D. H. J.

1904. *Measurement of Electrolytic Resistance.* **W. S. Franklin** and **L. A. Freudenberger.** (Phys. Rev. 25. pp. 294–302, Oct., 1907.)—The method adopted is based on the use of a transformer, the primary of which was supplied with alternating current and whose secondary consisted of a single "turn" of a liquid the resistance of which was to be measured. The liquid was contained in a glass ring vessel and the core of the transformer passed through the centre of the ring so that when the vessel was filled the iron core was surrounded by a closed turn of liquid of uniform cross-section.

In practice two transformers were used, the primaries being exactly alike: they formed two arms of a Wheatstone bridge. Balance was first obtained with the secondaries open-circuited and afterwards when closed. The secondary of one transformer was the ring electrolyte, that of the other consisted of 9 turns of wire so that the resistance necessary to balance the electrolyte of one turn had to be divided by 81 (the square of the ratio of the turns). An alternating-current galvanometer devised by the authors was used and was far more sensitive than any telephone employed by them. The resistances of a number of solutions of salts, bases, and acids of varying strengths were measured, and the values obtained agree very well with those given by Kohlrausch and Holborn. F. E. S.

1905. *Inductance of a Straight Conductor*. **K. Ogura** and **C. P. Steinmetz.** (Phys. Rev. 25. pp. 184–199, Sept., 1907.)—The self-inductance L of a length l of a straight conductor of radius a is given by—

$$L = 2l \log(D/a) \times 10^{-9}, \text{ henrys},$$

where D is the distance from the parallel return conductor and we suppose all the current on the surface of the conductor. If D be infinite the capacity is zero and the self-inductance infinite. In obtaining the formula for L, however, the magnetic field at all points is supposed to follow instantaneously changes in the value of the current. This assumption is only permissible when the distance between the conductors is a negligible fraction of the wave-length. It is obviously not permissible when the conductor has no return conductor. This case can be physically realised by a conductor perpendicular to the ground, provided there are no other vertical circuits—like trees, mountains, &c.—which may act as inductive returns. Since a vertical conductor in practice is limited in length, very high frequency must be used in order to obtain waves of moderate length. Let $i = I \sin \omega t$ represent the current. Then the magnetic induction B at the distance r is given by $B = (2I/r) \sin(\omega t - \alpha r)$, where $\alpha = \omega/v = 2\pi/\lambda$, and v is the velocity of light. Hence the total magnetic flux Φ surrounding the conductor from r to infinity is given by—

$$\Phi = l \int_a^{\infty} (2I/r) \sin(\omega t - \alpha r)\, dr$$

$$= 2Il\,[\sin \omega t \operatorname{col} \alpha a - \cos \omega t \operatorname{sil} \alpha a],$$

where col x and sil x are defined by—

$$\int_x^{\infty} \frac{\cos\theta}{\theta}\, d\theta = \operatorname{col} x \quad \text{and} \quad \int_x^{\infty} \frac{\sin\theta}{\theta}\, d\theta = \operatorname{sil} x.$$

Tables of these functions for various values of x could be readily computed from the formulæ given by the authors. The inductive back e.m.f. is $a\Phi/dt$ and is therefore given by—

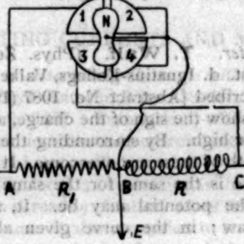
$$e = 2\omega Il[\cos \omega t \operatorname{col} \alpha a + \sin \omega t \operatorname{sil} \alpha a]$$

$$= (2\omega l \operatorname{sil} \alpha a)i + (2l \operatorname{col} \alpha a)(di/dt).$$

The first term is the watt component and the second the wattless component of the e.m.f. The latter leads the current by a quarter of a period. The energy component gives rise to an effective resistance $2\omega l \operatorname{sil} \alpha a$ and the "reactance" is $2\omega l$ col aa. The power radiated into space is $(2\omega l \text{ sil } aa)i^2$. The authors find formulæ for the self-inductance of a straight conductor of finite length and for the mutual inductance between two parallel finite straight conductors at a considerable distance apart. **A. R.**

1906. *Current Variations in Direct-current Dynamos.* **G. W. Berndt.** (Ann. d. Physik, 23. 4. pp. 805–806, Aug. 22, 1907.)—The author's observations supplement those of Athanasiadis [see Abstract No. 1396 (1907)], who obtained a note of constant pitch from a telephone inserted in the circuit of a direct-current dynamo. In carrying out various tests the author used a small horseshoe electromagnet in the circuit of a dynamo, and heard a distinct musical note, the frequency of which was proportional to the number of commutator segments, &c., of the machine. The same note was heard upon charging a newly erected battery of accumulators and also in special forms of resistances; the explanation of these singing resistances is probably similar to that of the singing arc. An arc lamp fed from the dynamo also emitted a musical note. **F. E. S.**

1907. *Determination of Inductances.* **G. Athanasiadis.** (Phys. Zeitschr. 8. pp. 606–607, Sept. 15, 1907. Écl. Électr. 53. p. 83, Oct. 5, 1907.)—The inductance to be determined is placed in series with another non-inductive coil of adjustable resistance; alternating sine currents are then passed through the two coils, and the p.d.'s at the ends of each coil are compared by mean of a quadrant electrometer used differentially. The Fig. shows the connections, and R_1 is adjusted until there is no deflection, when the inductance $L = \sqrt{(R_1^2 - R^2)}/2\pi n$, where n is the frequency and R_1 and R the two resistances. For telegraphic instruments and induction coils the accuracy obtained was 0·5 to 1 per cent. **G. E. A.**



1908. *Effect of Frequency upon Capacity.* **J. G. Coffin.** (Phys. Rev. 25. pp. 128–135, Aug., 1907.)—It is proposed to construct an absolute air condenser of two circular plates of optically plane glass. In order to render the two opposing faces of the plates conducting they are to be half-silvered, and the calculations of this paper were undertaken in order to find out how completely a condenser is charged and discharged when the condenser surface has a high resistance. The calculations are, however, perfectly general. In order to attack the problem mathematically it was necessary to assume the simple case of a uniform strip and that of an angular strip, this latter corresponding to a circular plate condenser. The results show that when the surface resistance is high, the capacity falls off to an enormous extent for comparatively low frequencies. Since the self-inductance of a coil also diminishes with increasing frequency, the results may serve to explain the observed deviations from the equation $T = 2\pi\sqrt{LC}$ in past experimental work. This remark applies all the more forcibly to work in which high frequencies are employed, such as wireless telegraphy. F. E. S.

1909. *Apparatus for obtaining Electric Arcs under Heavy Pressure.* **W. J. Humphreys.** (Astrophys. Journ. 26. pp. 36–40, July, 1907.)—The difficulty of maintaining a constant arc under heavy pressures is overcome by making one of the poles in the form of a disc and rotating it while the other in the shape of a rod or bar is brought up so as to touch it at some distance from the centre. A voltage of 220 is used. The pressure vessel is a forged cylindrical steel shell, 6 in. in diam. and 16 in. long, with walls 1¼ in. thick. A thick window of quartz is fastened down by a nut upon the end of a stout tube which is screwed into the side of the pressure vessel. The two electrodes are mounted upon rods which pass through stuffing boxes at each end of the pressure cylinder. In the case of the fixed electrode the rod carrying the current is mounted in a metal tube and fits tightly into an ebonite cap at one end and a mica block at the other; the annular space between the rod and tube is packed with ground mica. A somewhat similar arrangement is adopted at the other end, but the packing is finely-powdered graphite, which, while being perfectly air-tight, allows the rod to rotate freely. E. C. C. B.

1910. *New Electrometer.* **T. Wulf.** (Phys. Zeitschr. 8. pp. 527–530, Aug. 15, 1907. Phys. Inst. d. Ignatius-Kollegs, Valkenburg, July 1, 1907.)—The form previously described [Abstract No. 1087 (1907)] possesses two disadvantages: it does not show the sign of the charge, and its sensibility is less for low potentials than for high. By surrounding the two stretched threads by a metallic cylinder both of these are overcome. It has now the advantage that the calibration curve is the same for the same p.d.'s, no matter what the absolute value of the potential may be. It, moreover, follows very closely a straight-line law; in the curve given about 0·75 division for 1 volt. R. S. W.

1911. *An Electric Oscillograph.* **E. Taylor Jones.** (Phil. Mag. 14. pp. 238–254, Aug., 1907.)—The author has designed a short-period electrometer which is suitable for the determination of the frequency, and other characteristics, of electrical oscillations having periods greater than 1/1000 sec. The apparatus consists of a strip of phosphor-bronze parallel to, and between, the edges of two metal plates, one of which is connected to it and to one terminal of the instrument and the other is connected to the other terminal. The strip is thus attracted to one plate and repelled by the other when the terminals are connected to a source of voltage. A small mirror, the lower edge of which rests on a fixed platform, is attached to the middle point of the strip. The to-and-fro motion of the strip thus turns the mirror and deflects a beam of light thrown on to it, the deflections being proportional to the square of the p.d. The whole apparatus is submerged in oil to damp the natural vibrations. The beam of light is directed on to a concave rotating mirror which focuses it on a photographic plate side by side with a spot of light which is controlled by a tuning-fork. The author goes thoroughly into the theory of the instrument, and gives a table of results showing that the calculated and observed periods differ only in the fourth significant figure, and thus proving the accuracy of the instrument. Some excellent photographic records of damped and undamped oscillations are appended to the paper. J. E.-M.

1912. *Improved Universal Shunt-box.* **J. K. A. Wertheim-Salomonson.** (Electrician, 59. p. 954, Sept. 27, 1907.)—The Ayrton-Mather universal shunt-box contains a resistance which is connected across the terminals of the galvanometer, and part of the current flows through the tenth, the hundredth, or the thousandth part of this resistance. The sensitiveness of the galvanometer combined with the shunt is reduced in exactly the same proportion, but it is of advantage if the total resistance of the shunt-box is comparable with that of the galvanometer. In order to advantageously use the same universal shunt-box for every galvanometer, the author has added a dial switch which permits of part of the resistance being cut out of the galvanometer circuit so as to reduce its total resistance. The number of the useful shunting powers is, however, at the same time modified. In a shunt-box constructed for the author there are 11 shunt powers when the total resistance is 100,000 ohms, 9 for 10,000 ohms, 7 for 1,000 ohms, and 5 for 100 ohms. The shunt is particularly useful with moving-coil galvanometers, as it allows the sensitiveness as well as the damping to be modified.

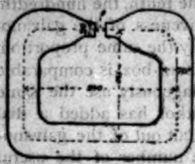
F. E. S.

ALTERNATING CURRENTS AND MAGNETISM.

1913. *Measurement of Alternating Currents with the Chord Galvanometer.* **Győző Zemplén.** (Phys. Zeitschr. 8. pp. 488–489, July 1, 1907. Electrician, 59. pp. 884–885, Sept. 6, 1907. Translation.)—Einthoven's chord galvanometer can also be used for alternate-current measurements if in place of the deflection the width of the oscillating chord or fibre be observed. The best condition of visibility for this observation is that the fibre appears bright on a dark ground, which is readily obtained when the fibre is illuminated from the side and the light-source is also somewhat to one side of the microscope's axis. The image is then a bright band on a dark ground, the edges being readable to 0·1 division of the scale. The sensitiveness is about the same as for direct current; 10^{-6} amp. gave an amplitude of 1 scale division (bright band 2 divs. wide, using the small Edelmann type). Wertheim-Salomonson's device of substituting parallel field wires for the magnetic field was also tried [Abstract No. 888 (1907)]. When the current passes through fibre and field wires in series a unidirectional deflection is obtained if the field wire currents are opposite; but the sensibility is small, only 2×10^{-4} amp. With the vibrating fibre, however, and 20 amps. through the field wires it is considered that the same sensitiveness should be obtainable as with direct current ($2{\cdot}5 \times 10^{-9}$ amp. $= 1$ mm.). Conversely, if a large current (40 amps.) is to be measured this should be passed through the field wires (in parallel) and a constant direct current of known value through the fibre. L. H. W.

1914. *Magnetic Susceptibilities of Crystals.* **W. Voigt** and **S. Kinoshita.** (Gesell. Wiss. Göttingen, Nachr., Math.-Phys. Klasse, 2. pp. 123–144, 1907.)—The magnetic susceptibilities in absolute measure are found for a number of substances including six specimens of glass, one of opal, seven regular crystals, eight magnetically-uniaxial crystals, and three crystals each with three magnetic axes. A small piece only of the test substance was used, and the attractive force it experienced in a magnetic field was measured by a torsion balance, the square of the field strength being determined by a bismuth spiral. E. H. B.

1915. *A Standard for Variable Magnetic Fields.* **R. Gans.** (Phys. Zeitschr. 8. pp. 523–527, Aug. 15, 1907. Physikal. Inst., Tübingen, July 25, 1907. Electrician, 60. pp. 168–170, Nov. 15, 1907. Abstract.)—An electromagnet is formed from a split ring of a material of high permeability, and analysis furnishes an expression giving the limits of that part of the B-H curve for which μ is a maximum, within which the field may be taken as proportional to the magnetising current. Hereafter, three standards are made of which the third has the shape and dimensions as shown. The core is soft cast Krupp steel and carries 1,700 turns; in it the field is proportional to the current, for currents between 1 and 8 amps. Its field si standardised ballistically by means of an iron-free coil of which the field has been otherwise determined. This standard has a range between 8,964 and 10,488 Gauss, and all three have been found of practical value in laboratory work. The apparatus has been patented. G. E. A.



1916. *Values of Demagnetising Factor for Cylindrical Iron Rods.* **C. L. B. Shuddemagen.** (Amer. Acad., Proc. 4. No. 6. pp. 185–256, Sept., 1907.)—The magnetising solenoids used by the author in his experiments were over 200 cm. in length (one having a length of 485 cm.), and had an outside diam. of 5·97 cm., and an inside diam. of 8·68 cm. The iron rods ranged in diam. from 0·24 cm. to 1·905 cm. The ballistic method of testing was used, the galvanometer being a four-coil instrument provided with an astatic system of needles and controlled by a magnet. The demagnetising factor N being defined by the equation $H_i = NI$, where H_i is the demagnetising force due to the polarity of the rod when its intensity of magnetisation is I, the author found that N was practically constant for a given rod so long as B did not exceed 10,000; but that for higher inductions N steadily decreased, finally reaching a value of ¼ or ⅓ of its value for weak inductions. Both the step-by-step and the reversal method was used, and it was found that when the solenoid was wound on a non-metallic tube, or a *split* brass tube, the reversal method gave values for N considerably lower than those obtained by the step-by-step method; but that when the solenoid was wound on a thick brass tube the agreement between the two methods was practically perfect. It has hitherto been customary to assume that, for a given value of I, the value of N depends only on the ratio of the length to the diam. of the rod, and is not influenced by the absolute dimensions of the rod. The author's experiments show, however, that N has larger values for the thinner rods, the differences in the values of N between diameters of 0·8175 cm. and 1·905 cm. ranging from 10 to 16 per cent. Most of the rods experimented on had values of N in the range of practical constancy (*i.e.*, in weak fields) considerably less than those given by Du Bois, but as the diameters of the rods decreased, Du Bois' values were approached. As regards the non-uniformity of magnetisation, this was found to be greatest in the region of maximum susceptibility, and to decrease on passing to either very strong or very weak fields. A. H.

1917. *Magnetic Hysteresis Phenomena.* **M. O. Bolser.** (Electrical World, 50. pp. 603–604, Sept. 28, 1907.)—A short sketch of the cause of hysteresis explained on Weber's molecular theory of magnetism. The author points out and shows by vector diagrams how hysteresis makes the effective resistance higher while the effective reactance is lowered, and further how, under proper conditions, with energy supplied from some source outside the electric circuit, the "hysteresis" loop may not only disappear, but that it can overturn and become negative. It is thus shown that while the molecular magnetic friction or real hysteresis is constant per cycle in a magnetic circuit, the "apparent" hysteresis can have many values depending on surrounding conditions. E. C. R.

1918. *Rise of the Current in the Coil of an Electromagnet.* **B. O. Peirce.** (Amer. Acad., Proc. 43. No. 5. pp. 99–182, Sept., 1907. Contribution from the Jefferson Phys. Lab., Harvard Univ.)—For the case of laminated cores a very complete historical, theoretical, and experimental discussion of the problem is given. The following subjects are considered in detail: the uses of exploring coils, fluxmeters and quantometers, self-inductance when the medium is magnetic, the effect of the magnetic properties of the core on the growth of current, the growth of the induction flux when the exciting current is maintained constant and the theoretical discussion of eddy currents. In discussing eddy currents, owing to the great complexity of the problem, the assumption is made that the permeability is constant. The results obtained, however, enable superior and inferior limits to be assigned to the eddy-current losses, and thus show when their effects can be neglected. A. R.

ELECTRO-PHYSIOLOGY AND ELECTRO-THERAPEUTICS.

1919. *Bactericidal Power of the Light from Cooper-Hewitt Lamps.* **Nogier** and **Thévenot.** (Archives d'Él. Médicale, 15. pp. 651–658, Sept. 10, 1907. Paper read before the Assoc. franç. pour l'avancement des Sciences, at Lyons.)—Cultures of various microbes were exposed for one hour or more to the light from a lamp of 800 c.p., at a distance of from 5 to 10 cm., but no effect could be observed on the vitality of the organism. The authors' explanation of this is that although it is true that the light from these lamps is very rich in chemical rays the luminosity is far below that of an arc lamp, and, moreover, the light is emitted from the surface of a long tube. For this latter reason a culture tube only receives one-sixtieth part of the total light given out. The difficulty would be overcome by employing a tube bent so as to allow of concentration of the light at a given point. H. W. P. Y.

REFERENCES.

1920. *Electric Dissipation in Air.* **G. Accolla.** (Accad. Gioenia, Atti, Ser. 4a. Vol. 20. N. Cimento, 13. pp. 435–443, May, 1907.)—Describes measurements made at Corso-Vigo, on the Sicilian east coast, and notes a particularly rapid dissipation at 6 a.m., when a S.E. wind blew in regularly from the sea. E. E. F.

1921. *Electric Conductivity of the Explosive Flame of CO.* **De Muynck.** (Annal. Soc. Sci. de Bruxelles, 31. 3. pp. 285–287, 1906–1907.)—Discusses the influence on the electric conductivity of this explosive flame of the various factors of the case, viz.: Composition of mixture, Dryness and homogeneity of mixture, Voltage, Temperature, and Pressure. E. H. B.

1922. *Electromagnetic Equations in Moving Media.* **F. Koláček.** (Ann. d. Physik, 23. 4. pp. 698–718, Aug. 22, 1907.)—A highly analytical paper on the basis of Hertz's equations. E. H. B.

1923. *Theory of the Production of Undamped Electrical Oscillations by Discharge through Gases.* **E. Riecke.** (Gesell. Wiss. Göttingen, Nachr., Math.-Phys. Klasse, 2. pp. 253–266, 1907.)—The author gives a mathematical theory of the unstable arc, based on certain assumptions. The results, however, are in several important respects not in agreement with experimental facts, the explanation of which is probably that certain quantities assumed constant are in reality variable. The equations agree with experiment in giving a smaller frequency than is given by the Kirchhoff-Thomson formula. J. E.-M.

1924. *Resistance of a Wire by Reflection of Electric Waves.* **W. v. Ignatowski.** (Ann. d. Physik, 23. 5. pp. 905–906, Sept. 24, 1907.)—On the basis of a previous investigation [see Abstract No. 184 (1906)] a method of calculating the resistance of a wire is here pointed out. The result is in agreement with an expression found by J. J. Thomson in "Recent Researches in Electricity and Magnetism." E. H. B.

1925. *Portable Drop-collector for Atmospheric Potential Measurements.* **V. Conrad.** (Phys. Zeitschr. 8. pp. 672–674, Oct. 15, 1907. K.K. Zentralanstalt f. Meteorologie, Wien, Aug., 1907.)—Illustrated description.

1926. *Effect of Electricity upon Plants.* **J. H. Priestley.** (Electrician, 59. pp. 827–829, Sept. 6, 1907. Abstract of paper read before the British Naturalists' Society.)

1927. *Thermo-electromotive Forces of Potassium and Sodium with Platinum and Mercury.* **H. C. Barker.** (Amer. Journ. Sci. 24. pp. 159–166, Aug., 1907.)—Measurements were made of the thermo-e.m.f.'s of potassium-platinum and sodium-platinum couples for varying temperature-differences between 0° and about 90°, and for the purpose of comparison of a mercury-platinum couple through the same range, by a potentiometer method. It is intended to make further observations with improved apparatus and purer metals, and the values given in the paper are presented as preliminary approximations rather than as final results. J. J. S.

1928. *Compensation Apparatus.* **W. P. White.** (Zeitschr. Instrumentenk. 27. pp. 210–219, July, 1907. Geophys. Lab., Carnegie Inst. of Washington, March, 1907. From the English.)—An account of a method by which small resistance with avoidance of contact errors is obtained and the application of this and similar corrections to the construction of compensation apparatus in which the resistance of the galvanometer is constant. Details are given of the arrangement for avoiding errors due to thermo-e.m.f.'s. J. J. S.

1929. *Earth-magnetism.* **L. Baumgardt.** (Phys. Zeitschr. 8. pp. 303–306, May 1, 1907.)—A mathematical discussion of the heat developed in a suspended coil swinging to and fro in the earth's magnetic field. Account is taken of the earth's rotation. A. W.

1930. *Hypothesis of the Molecular Field and Ferromagnetism.* **P. Weiss.** (Soc. Franç. Phys., Bull. 1. pp. 95–96, and pp. 97–124, 1907. Journ. de Physique, 6. pp. 661–690, Sept., 1907.)—A discussion of the phenomena of ferromagnetism on the supposition that each molecule experiences from the action of the molecules round it an effect equal to that it would experience if in a uniform field proportional to the intensity of the magnetisation and in the same direction. This hypothetical field is styled the "molecular field." [See also Abstract No. 1449 (1905).] E. H. B.

1931. *Magnetic Induction in Spheroids.* **D. N. Mallik.** (Asiatic Society, Journ. Phil. Mag. 14. pp. 455–468, Oct., 1907.)—A mathematical treatment.

CHEMICAL PHYSICS AND ELECTRO-CHEMISTRY.

1932. *Quantitative Synthesis of Silver Nitrate: Atomic Weights of Nitrogen and Silver.* **T. W. Richards** and **G. S. Forbes.** (Amer. Chem. Soc., Journ. 29. pp. 808–826, June, 1907. Contribution from the Chem. Lab. of Harvard College.)—Careful measurements, made with all possible precautions, lead to the result that 100 gm. of silver yield 157·479 gm. of silver nitrate. Taking Ag = 107·93, the atomic weight of nitrogen is 14·037; whilst if Ag = 107·88, it becomes 14·008. Further experiments are in progress to decide between these two values. T. H. P.

1933. *Molecular Weight of Silver Sulphate and Atomic Weight of Silver.* **T. W. Richards** and **G. Jones.** (Amer. Chem. Soc., Journ. 29. pp. 826–844, June, 1907. Contribution from the Chem. Lab. of Harvard College.)—By heating silver sulphate in a current of hydrogen chloride, it is completely converted into silver chloride. Working in this way, the authors find that 100 parts of silver sulphate yield 91·933 parts of the chloride. If Ag = 107·93, S = 32·113, and if Ag = 107·88, S = 32·069 [compare preceding Abstract]. The sp. gr. of silver sulphate (after fusion) is found to be 5·45. T. H. P.

1934. *Studies of the Perhalogen Salts.* I. **C. K. Tinkler.** (Chem. Soc., Journ. 91. pp. 996–1003, June, 1907.)—It was found that N/1000 iodine, dissolved in water, chloroform or alcohol, showed no absorption band and very little general absorption in the ultra-violet in thicknesses not exceeding 25 mm.; on adding KI, however, two ultra-violet absorption bands and a very marked general absorption were noticed; this was attributed to the formation of periodides, and was used as a method of detecting them. Identical spectra were found when iodine was mixed with HI, NaI, KI, BaI_2, MgI_2, CdI_2, AlI_3, NH_4I, and $N(CH_3)_4I$: in each case also the visible colour changed from reddish-brown to yellow; the spectrum is, therefore, attributed to the ion I_3. It is noteworthy that cadmium periodide, which is not formed in nitrobenzene, exists to a very marked extent in aqueous solutions.

T. M. L.

1935. *Corrosion of Iron and Steel.* **W. H. Walker, Miss A. M. Cederholm,** and **L. N. Bent.** (Amer. Chem. Soc., Journ. 29. pp. 1251–1264, Sept., 1907. Contribution from the Research Lab. of the Massachusetts Inst. of Technology, No. 8.)—A summary of the results hitherto obtained in the investigation of the rusting of iron is first given. The authors have very carefully repeated Moody's experiments [see Abstract No. 1189 (1906)], using, in one experiment ordinary glass, and in another Jena glass which had been steamed for two days. In the first case the results were in complete accordance with those of Moody, but it was found that the water had attacked the glass and become alkaline. In the second case the water did not become alkaline, and the iron rusted almost as readily as in the open air. The authors conclude that the non-rusting in the first case was due to the inhibiting effect of the free alkali, and that iron does rust in the presence of air containing no CO_2, as was found by Dunstan, Jowett, and Goulding [see Abstract No. 198 (1906)]. It is further pointed out that the experiments in which Moody used chromic acid are worthless, since iron is rendered passive by immersion in chromic acid or potassium dichromate. Dunstan and his co-workers could not confirm Whitney's result, that iron dissolves in water free from oxygen and CO_2; but the authors substantiate the work of Whitney, pointing out that the water which has been in contact with the iron must be concentrated before the test for iron is made. It is also shown that the rusting of iron is an electrolytic process, by the following experiment: A piece of iron is immersed in water, to which has been added a little phenol phthalein and a trace of potassium ferricyanide. Within a few minutes the iron is seen to divide itself into zones or surfaces, which exhibit opposite polarity; the anodic portions become coated with a precipitate of Turnbull's blue, and the kathodic parts with a bright red precipitate of iron rust. It is further shown: (1) That the primary function of oxygen in the corrosion of iron is in depolarising those kathodic portions of the iron upon which hydrogen tends to precipitate, and that a secondary function is the oxidation of the ferrous iron to the ferric form, with its subsequent precipitation as ferric hydroxide. (2) That the rapidity of corrosion in water is a linear function of the partial pressure of the oxygen in the atmosphere above the water. (3) That an electric current can pass between bright iron and iron covered with scale, (*a*) if the concentration of the hydrogen ions be increased by the presence of an acid, or (*b*) if oxygen or some other depolarising substance be present. (4) That in certain instances, areas having marked difference in potential exist in far greater number upon the surface of a piece of iron prone to corrosion than upon iron which is resistant to corrosion. The authors consider that the formation of H_2O_2 (cf. Dunstan's theory) is incidental to, and not necessary for corrosion. The fact that iron does not rust in pure H_2O_2 may be due to the inhibiting effect of the latter, since the law of mass action demands that the formation of a substance be limited by the concentration of that already formed; or it may be that the iron is rendered passive by the H_2O_2. T. S. P.

1936. *Transformation of Yellow into Red Phosphorus.* **F. Zecchini.** (Gazzetta Chim. Ital. 37. 1. pp. 422–423, 1907.)—The transformation of yellow into red phosphorus may be readily demonstrated as follows: About 10 c.cm. of the phosphorus, dried between filter-paper, is introduced in small pieces into a glass tube having a length of about 80 cm. and a diam. of about 7–8 mm., and sealed at one end. The part of the tube containing the phosphorus is heated in a sulphuric acid bath to 180°. On allowing a flake of iodine to fall on to the surface of the molten phosphorus, the whole or the greater part of the latter passes immediately into the red modification. Investigations are being carried out to ascertain whether the phenomenon is catalytic or whether any intermediate reaction occurs. T. H. P.

1937. *Calorimetric and Cryoscopic Study of Mercuric Iodide.* **Guinchant.** (Comptes Rendus, 145. pp. 68–70, July 1, 1907.)—Using the methods previously described [Abstract No. 1988 (1904)], the author obtains the following constants for mercuric iodide. Latent heat of fusion at 250°, 9·79; specific heats, 0·0406 (red, solid), 0·0446 (yellow, solid), and 0·0554 (fused); heat of transformation of 1 kg. of yellow iodide into the red modification at 130°, 1·58 cal. The theoretical value of the cryoscopic constant, calculating from the above number for the heat of fusion, is $K = 550$; the experimental number, derived from measurements of the freezing-point depressions of lead, silver, potassium, and mercurous iodides in mercuric iodide, is 580–585. Mercuric oxide and chloride and mercurous chloride, when dissolved in mercuric iodide, have abnormally low molecular weights. T. H. P.

1938. *Calorimetry of Silver Nitrate at High Temperatures.* **Guinchant.** (Comptes Rendus, 145. pp. 320–322, July 29, 1907.)—The heat of fusion of silver nitrate, determined by the ordinary calorimetric method, is 17·6 cals. This gives a value of 5·8 for the quotient LM/T, whilst de Forcrand's rule gives the number 10. Measurements made with an electro-calorimeter, which is found to give good results for the heats of fusion of mercuric iodide and tin, gives the value 17·9 cals. for that of silver nitrate. T. H. P.

1939. *Production of High Temperatures by Electrical Heating of Oxides.* **B. Saklatwalla.** (Zeitschr. Elektrochem. 13. pp. 589–592, Aug. 30, 1907. From the Metallhüttenmänn. Laborat. d. techn. Hochschule, Berlin. Engineering, 84. pp. 497–498, Oct. 11, 1907.)—Describes a form of tube resistance-furnace, in which the heating is performed in three stages. The first is by nickel strip wound on a magnesia cylinder. Within is a tube of SnO_2, which is used as conductor when the temperature reaches about 600°. Concentrically within this tube is another of magnesia, which becomes a conductor for temperatures of 1,500° and upwards. 1,750° was observed, by means of the Wanner pyrometer, and the temperature was carried to the fusion of the platinum-iridium leads. Rough measurements of the resistances of these and other oxides at various temperatures are given, together with the reasons which led to the adoption of SnO_2 and MgO. F. R.

1940. *Aluminium Carbide.* **C. Matignon.** (Comptes Rendus, 145. pp. 676–679, Oct. 21, 1907.)—The author has prepared carbide of aluminium, C_3Al_4, by heating a mixture of lampblack and powdered Al, in excess, in a Perrot furnace, or by means of an oxy-acetylene flame. The same mixture will unite if it be heated, in air, to a high temperature at one point only. Another method of preparation is by the action of Al on the chlorides of carbon, *e.g.*, by heating a mixture of Al and C_6Cl_6 to 225° in a sealed tube, the pure carbide can be obtained. HCl acts upon the carbide, giving methane; this is a distinctive proof that the carbide has been formed. The author is applying the latter type of reactions in the preparation of other carbides. F. R.

1941. *Tellurium-Tin Alloys.* **H. Fay.** (Amer. Chem. Soc., Journ. 29. pp. 1265–1268, Sept., 1907.)—The compound SnTe was observed, which melts at 769°. This forms a eutectic with Te containing 85 per cent. Te, and solidifying at 400°. It also forms a eutectic with Sn, solidifying at 232°, *i.e.*, the same point as pure Sn. The concentration of this eutectic could not be exactly ascertained; it is extremely low in Te. This series is closely analogous to the Pb-Te series. F. R.

1942. *Silicon Copper.* **M. Philips.** (Metallurgie, 4. pp. 587–592, Sept. 8, and pp. 613–617, Sept. 22, 1907.)—Upon heating a block of copper in silicon powder, no "cementation" whatever occurred, but Cu turnings embedded in finely-powdered crystalline Si, and heated for 5 hours at 700° to 750°, contained 9·56 per cent. Si. Upon repeating Vigouroux' work the author concluded that Cu_3Si did not occur. He suspected and confirmed a source of error in the ordinary method of estimating free and combined Si in copper silicons, *i.e.*, heating and afterwards treating the mixture of Si and SiO_2 with hydrofluoric acid; this gives free Si low and combined Si high. He gives another method: the mixture of Si and SiO_2 remaining after treatment of the silicon copper with aqua regia is dissolved in hot caustic potash; the evolution of H gives the free Si; [$Si + 4KOH = K_4SiO_4 + 2H_2$]; and the potassium silicate gives the SiO_2. By this method copper silicons made by melting together Cu and Si are found to contain free Si and an alloy corresponding closely to the formula Cu_7Si_2. Copper silicons do not result from heating together CuO and SiC. It is found that the ratio of free to combined Si does not depend upon the rate of cooling, the only difference between specimens quenched and slowly cooled from the molten state being a more perfect crystallisation of the free Si with slower cooling. Silicon copper decomposes water readily at temperatures of 65° and higher. Hydrogen only is evolved; there is no trace of silicon hydride. F. R.

1943. *Reduction and Formation of Carbide of Iron.* **R. Schenck, H. Semiller,** and **V. Falcke.** (Ber. Deut. Chem. Gesell. 40. pp. 1704–1725, 1907. Soc. Chem. Ind., Journ. 26. pp. 692–693, June 29, 1907. Abridged.)—The results of the author's further investigation of the equilibrium pressure in the system Fe, FeO, C, CO, and Co_2 at varying temperatures show that the curves for CO and for graphite, though very nearly coincident, are quite independent of one another; for the complete determination the proportions of CO and CO_2 must be known. Mixed crystals of Fe_3C and Fe appear above 700°, hence the experiments were made below this temperature. From the results for the systems (I.) Fe, FeO, C (amorphous), CO, and CO_2; (II.) Fe, FeO, C (graphite), CO, and CO_2; (III.) Fe_3C, FeO, C (amorphous), CO, and CO_2; (IV.) Fe_3O_4, FeO, C (amorphous), CO, and CO_2, it is concluded that cementation of iron is only possible when the gas contains 96 to 99 per cent. CO. This was approximately verified by heating reduced white cast-iron in CO. The heat of formation of Fe_3C calculated from the data by van't Hoff's equation is 8,940 cal., cementite being an exothermic compound. F. R.

1944. *Affinity between Sulphur and certain Metals.* **E. Schütz.** (Metallurgie, 4. pp. 659–667, Oct. 8, and pp. 694–700, Oct. 22, 1907. Communication from the Aachener Inst. f. Metallhüttenw. u. Elektrometall.)—The following metals are arranged in the order of their affinity for S: Mn, Cu, Ni, Fe, Sn, Zn, Pb. CaS has a prejudicial effect in the reduction of lead sulphide ore, BaS has not. F. R.

1945. *Sentinel Pyrometers and their Application to the Treatment of Tool Steel.* **H. Brearley** and **F. C. Moorwood.** (Iron and Steel Inst., Journ. 73. pp. 261–273; Correspondence, pp. 273–275, 1907. Mech. Eng. 19. pp. 729–731, May 25, 1907. Abstract. Metallurgie, 4. pp. 379–385, June 8, 1907.)—The pyrometer consists, according to the degree of temperature to be dealt with, of either cast cylinders of salts of known melting-points, or of cylinders of alloys of definite known melting-point. The salt cylinders are used in the same way as Seger cones are, while the alloy is, for higher temperatures, caused to interpose a break in an electrical circuit, which is removed on the alloy melting, when a bell rings giving warning of the temperature. Their application in the hardening of tool steel is described. L. H. W.

1946. *Relation between Process of Manufacture and Properties of Steel.* **F. W. Harbord.** (Iron and Steel Inst., Journ. 73. pp. 181-197; Discussion and Correspondence, pp. 197-199, 1907. Engineering, 83. pp. 791-793, June 14, 1907. Stahl u. Eisen, 27. pp. 817-819, June 5, 1907. Metallurgie, 4. pp. 371-379, June 8, 1907.)—From experiments on 58 steels made by the acid and basic Bessemer and open-hearth processes, which were selected for similarity in composition for a given carbon content and which were tested as rolled and after annealing for 20 min. at 620° C., and also from data collected from various sources, the following conclusions are reached. In steels of 30 or more tons per sq. in. tensile strength, about 0·1 per cent. more carbon is required in basic open-hearth than in acid Bessemer for the same strength. Similarly, acid open-hearth requires slightly more carbon than basic Bessemer. That it is safe to allow the manufacturer to vary the composition in order to obtain a specified strength is proved by experience, and also by the fact that reasonable elongation and contraction are obtained with the increased carbon required. The following table is the mean of the experimental and collected results, showing the percentage of carbon required for a given ultimate stress :—

Ultimate Stress Tons per sq. in.	Basic Open-hearth.	Acid Open-hearth.	Basic Bessemer.	Acid Bessemer.
25	0·126	0·110	0·087	—
30	0·25	0·177	0·170	0·135
35	0·36	0·335	0·265	0·246
40	0·432	0·407	0·385	0·350
45	0·505	0·475	0·461	0·428
50	0·585	0·556	0·524	0·495

The hardness tests, by the Brinell method, followed the tensile test figures. In the *discussion*, **P. C. Gilchrist** attributed the greater hardness of acid Bessemer steels to dissolved oxygen or iron oxide, and **E. Adamson** suggested that the higher the temperature at which a steel was made, the softer it is for the same carbon content. The **Author** did not agree with the last suggestion; he would endeavour later to give figures showing the oxygen present in the steels. F. R.

1947. *Ageing of Mild Steel.* **C. E. Stromeyer.** (Iron and Steel Inst. Journ. 73. pp. 200-254; Discussion and Correspondence, pp. 255-260, 1907. Engineering, 83. pp. 725-729, May 31, and pp. 757-760, June 7, 1907. Metallurgie, 4. pp. 385-414, June 8, 1907.)—A variety of instances are described in which the properties of steel appear to have changed upon keeping. For example, pieces, sheared from the edges of plates, at once gave good bending tests, but after several days were very brittle. On the other hand, some spring makers prefer steel which has been stocked for a long time, and some steel makers prefer to forge ingots which have been kept for some time. The results of some 800 tests of varied nature on about 30 different samples of steel—mostly boiler-plates which have failed in service—are in several respects inconclusive. The author considers, however, that the test which gives results most in accord with experience is to nick two planed samples to the same depth (he uses a chisel with shoulders), and to test one of them by bending at once and the other by bending after several weeks' rest, or after heating in boiling water for say 15 min. Nearly all the faulty steels thus appeared worse in the second bending test, with the exception of those with particularly high phosphorus. Bad steels are, as a rule, most brittle when tested at temperatures below 0° C. He called attention to some cases in which soft iron from which boilers had been made, which had given good service for many years, and which had given excellent test results at the time of manufacture, was useless when cut up, being both hot and cold short. In the *discussion*, **F. W. Paul** quoted the results of tests of the wire used in the cables of the Niagara Suspension Bridge since 1855. This gave 95 per cent. of the original strength with 60 per cent. reduction of area, indicating no certain deterioration. F. R.

1948. *Influence of Conditions of Casting on Piping and Segregation.* **H. M. Howe** and **B. Stoughton.** (Amer. Inst. Mining Engineers, Bull. 16. pp. 561–578, July, 1907.)—The following propositions, made by one of the authors [see Abstract No. 1281 (1907)], are verified in the present paper by experiments upon wax ingots containing a little copper oleate and red cerasine: that the pipe is shortened and the segregate raised by casting slowly, with the large end up, and by retarding the cooling of the top; that the pipe is shortened by slow cooling; and that the pipe and segregate lie in the last-freezing portion. Photographs of sections of the wax ingots are given. F. R.

1949. *The Iron-Carbon Phase, "Osmondite."* **H. M. Howe.** (Electrochem. Ind., N.Y. 5. pp. 347–350, Sept., 1907.)—Discusses the conclusions of Heyn and Bauer and Osmond's views [Abstracts Nos. 1483 (1906) and 342 (1907)]. Whilst following the views of those authors generally, he calls for caution in accepting the strain-hardening explanation of the hardness of osmondite. Little is known as to its hardness. If it should appear, however, that it is but little harder than pearlite, then the strain-hardening explanation becomes probable; if greatly harder, then osmondite must contain hardening carbon. Similarly, strain-hardening is held to be an insufficient explanation of the hardening of steel by quenching. F. R.

1950. *Viscosity of Solutions.* I. **C. Ranken** and **W. W. Taylor.** (Roy. Soc. Edinburgh, Trans. 45. 15. pp. 397–406, 1906.)—1. The curves connecting viscosity and concentration in the case of potassium chloride do not extrapolate to the viscosity of the solvent for zero concentration and probably pursue a complex course at great dilutions. At 25°, at concentrations between 1 and 2 mols. per litre, the viscosity (which at greater concentrations is less than that of the solvent) becomes slightly greater than unity; at 1 mol. per litre it is < 1, but increases again to 1 at 0·1 mol. per litre. 2. Negative values for the viscosity of the solute were at first observed only in aqueous salt solutions. Mühlenbein and Wagner have recently recorded a few examples amongst organic compounds—*e.g.*, cyanobenzene in ethyl alcohol; to these the authors now add the case of carbamide in water, which at 8° C. and 0·08 mol. per litre gives a viscosity only 0·9985 compared with that of the solvent as unity. 3. A solution of potassium chlorate containing 0·8 mol. per litre has a viscosity at 80°, equal to that of the solvent. When this was used as a solvent for ammonium iodide and for carbamide the viscosities of the solutions were at small concentrations equal to those of solutions in water alone; at higher concentrations small deviations were noticed. T. M. L.

1951. *Viscosity Measurements.* **K. Beck** [with **K. Ebbinghaus** and **W. Treitschke**]. (Zeitschr. Phys. Chem. 58. pp. 409–419 and 425–441, March 15, 1907.)—(1) Oil suspended in water does not alter the viscosity, but when emulsified the viscosity is increased. (2) Measurements are given of the relative viscosity of chloroform compared with alcohol and water in tubes of different dimensions so as to determine the effect of the velocity with which the liquid leaves the capillary. (3) Isomorphous mixtures when fused were found to give a linear relationship between viscosity and composition. (4) The viscosity of fused sulphur may be used to indicate the relative proportions of the crystalline and amorphous forms. (5) Attempts were made to determine by means of viscosity measurements the dissociation of compounds such as *p*-toluidine phenate. T. M. L.

1952. *Discontinuities in the Molecular Conductivities of Solutions of Chromium Sulphate.* **A. Colson.** (Comptes Rendus, 145. pp. 250–252, July 22, 1907.)—The conductivities of solutions of chromium sulphate ($\frac{1}{10}$ $Cr_2(SO_4)_3$ per litre), of both the violet and green varieties, were measured. The results obtained showed a difference from those of Kohlrausch, and the conductivities were also changed if the salt or solution were heated. The author seeks to explain these anomalies by the hydrolysis of the chromium salts, whereby complexes are formed thus—

$$2Cr_2(SO_4)_3 + H_2O = H_2SO_4 + Cr_4O(SO_4)_5$$

and—

$$Cr_4O(SO_4)_5 + 2H_2O = H_2SO_4 + 2Cr_2(SO_4)_2(OH)_2,$$

the observed result being a superposition of these two hydrolyses. F. J. B.

1953. *Specific Heat of Solutions.* **W. F. Magie.** (Phys. Rev. 25. pp. 171–188, Sept., 1907.)—Examination of the heat capacities and specific volumes of 18 electrolytes shows that they are representable by expressions of the form $NW + A + Bp$ and $NU + D + Ep$, where A, B, D, E are constants, N the number of gm.-mols. of water (for which W is the molecular heat and U the molecular volume) to each gm.-mol. of the solute, and p the dissociation-factor, *i.e.*, the ratio of the molecular conductivity of the solute in a solution of the given concentration to the molecular conductivity of the same solute in an infinitely dilute solution. It is then shown that expressions of these forms result from the hypothesis that each actual molecule and each ion of the solute collects around itself a group of water molecules, and in general affects and modifies the heat-capacity and volume of the group, and that the heat-capacity of the solution is the sum of the heat-capacities of the several homogeneous parts of the solution, *i.e.*, of the water outside all the groups affected, of the undissociated molecules and the water affected by them, and of the ions and the water affected by them; and similarly for the volumes. Formulæ of the same kind with $p = 0$ are satisfied by the data for non-electrolytic solutions except those in which some obvious interaction occurs between the solute and solvent, as in the case of alcohol and water. The theory further indicates that the influence of ions of various sorts upon the surrounding water molecules may in many cases be practically the same, sodium compounds acting in one way, potassium compounds in another. Other deductions from the theory are also discussed. R. E. B.

1954. *Variation of Vapour Pressure as a Function of the Temperature, and the Determination of Ebullioscopic Constants.* **G. Baume** and **D. E. Tsakalotos.** (Comptes Rendus, 144. pp. 873–876, Feb. 18, 1907.)—The heat of vaporisation, L, of a liquid can be calculated from the equation $L = (RT^2/JMp)dp/dT$, and also from van't Hoff and le Chatelier's expression $L = 0{\cdot}02T^2/E$; whence $dp/dT = 0{\cdot}01Mp/E$ since R/J is equal to 2. The derived relation may be used to study the variation dp/dT of the vapour tension with the temperature, at temperatures near the boiling-point under the pressure p, provided the value of E is known; E in the formula is the molecular elevation of the boiling-point of the liquids when used as solvents, M is the molecular weight of the vapour of the liquid. Using Beckmann's values of E in the estimation, the calculation of the elevation ΔT of temperature corresponding to a 1-mm. variation of pressure Δp gave figures agreeing well with the experimental results in the case of water, alcohol, ether, acetone, chloroform, ethylene bromide, benzene, aniline, phenol, carbon bisulphide, sulphur dioxide, and also, if allowance was made for polymerisation, in the case of acetic acid. As shown by the authors, the equation may also be used satisfactorily to calculate E for liquids of which the molecular weight and the variation of the vapour pressure with temperature are known. D. H. J.

1955. *Application of Trouton's Law to the determination of the Molecular Elevations of the Boiling-points of Solutions.* **D. E. Tsakalotos.** (Comptes Rendus, 144. pp. 1104–1106, May 21, 1907.)—From Nernst's expression for Trouton's law, $ML/T = 9{\cdot}5 \log T - 0{\cdot}007T$, and the equation $E = 0{\cdot}02T^2/L$, the author derives the expression $E = M/(475 \log T/T - 0{\cdot}35)$, where E represents the molecular elevation of the absolute boiling-point T of a solvent having the molecular weight M. From this equation are calculated the values of E for the solvents oxygen, chlorine, bromine, sulphur dioxide, ether, acetone, carbon disulphide, chloroform, carbon tetrachloride, ethylene dibromide, benzene, nitrobenzene, and aniline, the numbers agreeing well with Beckmann's experimental numbers and with those given by van't Hoff's equation. The equation cannot be applied to the case of bodies polymerised in the liquid state, since the value of L is then influenced to a far greater extent than that of T; the expression can hence serve as a criterion of the molecular association of a body. Since the expression ML/T has been shown to be approximately constant for the members of a homologous series even when they are associated, the equation $E/E_x = MT/M'T'$ can be used for the calculation of the ebullioscopic constants of a homologous series if that of one of the members is known; calculation of the constants for methyl, propyl, *iso*butyl and *iso*amyl alcohols from the constant for ethyl alcohol gives accurate results. The equation $E/E_x = MT/M'T'$ is also applicable in the case of substances polymerised in the gaseous state, when the values for M calculated from the densities at the boiling-points are substituted. T. H. P.

1956. *Bearing of actual Osmotic Experiments upon the Conception of the Nature of Solutions.* **L. Kahlenberg.** (Faraday Soc., Trans. 3. pp. 22–26; Discussion, pp. 27–37, July, 1907.)—The author gives here the substance of a paper already abstracted [Abstract No. 1142 (1906)]. He points out the specific quality of the membrane used to separate the two liquids, and objects to the thermodynamic deductions of osmotic pressure, as they postulate a semi-permeable membrane, which is at the same time passive. In the *discussion*, **H. N. Morse** contributed the results of measurements of the osmotic pressure of glucose and cane-sugar solutions [see next four Abstracts] pointing out how the agreement between the osmotic pressure and the calculated gas pressure was much better when one expressed the concentration of the solutions in gm.-mols. of solute per gm. of solvent. **J. C. Philip** referred to the thermodynamic deduction of PV = RT, and **A. Findlay** pointed out that the objection of Kahlenberg to the application of thermodynamics to the problem of osmotic pressure was due to a misunderstanding of the meaning of a thermodynamically passive membrane. He also pointed out that in the discussion of osmotic pressure a distinction must be drawn between the quantitative theoretical connection between pressure and concentration, and the speculations as to why osmotic pressures are produced at all. **W. C. D. Whetham** also referred to the thermodynamic treatment of the subject, and pointed out that the experiments of Kahlenberg though of interest for osmosis through actual membranes, have no bearing at all on the general theory of solution. A. F.

1957. *Osmotic Pressure of Cane-sugar Solutions at 0° C.* **H. N. Morse, J. C. W. Frazer,** and **W. W. Holland.** (Amer. Chem. Journ. 37. pp. 425–467, May, 1907.)—The chief conclusion arrived at from the long series of experiments recorded in the present paper is that whilst cane-sugar at 20° exhibits a normal osmotic pressure, at 0° the osmotic pressure exceeds the calculated pressure by an amount that varies from about 5 to about 10 per cent. The full discussion of this important result is postponed until more experimental data are available. T. M. L.

1958. *Osmotic Pressure of Cane-sugar Solutions in the Vicinity of 5°.* **H. N. Morse, J. C. W. Frazer,** and **P. B. Dunbar.** (Amer. Chem. Journ. 38. pp. 175–226, Aug., 1907.)—Measurements of the osmotic pressure of cane-sugar solutions at 5° show deviations from the calculated values similar to those recorded at 0° [preceding Abstract]. It is remarkable that these deviations are of such a character that the osmotic pressures are almost constant from 0° to 20°, but the authors are inclined to assume some secondary change to account for the deviations rather than to suppose that osmotic pressure really has no temperature-coefficient; they are confirmed in this opinion by the fact that freezing-point measurements show corresponding deviations. T. M. L.

1959. *Osmotic Pressure and Depression of the Freezing-point of Solutions of Glucose.* **H. N. Morse, J. C. W. Frazer,** and **B. F. Lovelace.** (Amer. Chem. Journ. 37. pp. 324–360, April, 1907.)—Measurements are given of the osmotic pressure of glucose at temperatures between 21° and 27°, the experimental methods being essentially similar to those employed in the case of cane-sugar. It was found that the glucose at concentrations ranging from N/10 to N (pressures 2·4 to 24 atmos.) exerted an osmotic pressure equal to the pressure which would be produced by an equivalent quantity of a gas if contained in a volume equal, not to that of the solution, but to that of the pure solvent in which the sugar was dissolved. The behaviour of glucose is thus entirely analogous to that of cane-sugar, and in each case the conclusion is drawn that the sugar at temperatures above 20° C. exists in an *anhydrous* condition in the solution. As showing the degree of accuracy attained it may be noted that the largest difference between the observed and calculated osmotic pressures was 0·21 atmo. on a total of 22 atmos., whilst the values for the molecular weight calculated from the observed osmotic pressures were

180·62, 181·94, 181·06, 180·62, 179·35, 179·62, 179·68, 179·76, 179·99, and 179·04 as contrasted with the theoretical value 178·74. In almost every case the observed pressure was a trifle smaller than the calculated pressure. Observations of the freezing-points of glucose solutions showed a remarkable constancy in the molecular depression for weight-normal solutions, suggesting that even at 0° the sugar is anhydrous. T. M. L.

1960. *Osmotic Pressure of Glucose Solutions at 0° C.* **H. N. Morse, J. C. W. Frazer,** and **F. M. Rogers.** (Amer. Chem. Journ. 37. pp. 558–595, June, 1907.)—In these experiments the loss of rotatory power of the sugar solution during the experiment was reduced to less than 1 per cent., the corresponding changes in the earlier series being about 8 per cent., 1·5 per cent., and 1·5 per cent. The improvement was mainly due to decreased displacement of the manometer, increased rapidity of opening and closing the cells, and the practice of dipping the cells before closing in a sugar solution instead of placing directly in water. In the present series of experiments it was found that the osmotic pressure was greater than the calculated value by about 5 per cent.; this deviation is less than in the case of cane-sugar and is practically independent of the concentration. It is noteworthy that the molecular depression of the freezing-point for aqueous solutions of glucose is in excess of the theoretical value by about an equal amount, viz., 4 per cent., so that the two deviations may probably be referred to one and the same cause. It is also noteworthy that in the case of cane-sugar, where the deviation varies with the concentration, it appears to vary in a very similar way in the osmotic and in the cryoscopic measurements.

T. M. L.

1961. *Freezing-point Depression in Dilute Solutions of strongly-dissociated Electrolytes.* **H. Jahn.** (Zeitschr. Phys. Chem. 59. pp. 31–40, April 28, 1907. From the physikal.-chem. Inst. d. Univ., Berlin.)—In order to determine the freezing-points of very dilute solutions a series of 100 silver-constantan thermo-junctions was used in place of a mercury thermometer to record the difference in temperature between the solution and pure water when both were beginning to freeze. In this way readings could be obtained within 0·000001° C., and the observations were extended to a dilution of N/100 or beyond. The salts employed were sodium and potassium chloride, chlorate, bromate, and iodate, and the relationship between freezing-point and concentration is expressed in each case by means of a quadratic formula. The freezing-points give values for the coefficient of ionisation which differ from those calculated in the ordinary way from the molecular conductivities of the solutions. This difference is attributed by the author to variations in the mobility of the ions as the concentration is changed, and on the assumption that the freezing-points give correct values for this coefficient he calculates the values of the ionic mobilities at different concentrations.

T. M. L.

1962. *Indicators for Acids and Alkalies.* I. **E. Salm** and **H. Friedenthal.** Zeitschr. Elektrochem. 13. pp. 125–130, April 5, 1907.)—As evidence that the change of colour in an indicator is due to a change of structure, and not, as Ostwald supposed, to a change from the ionised to the non-ionised condition, or *vice versâ*, the fact is quoted that in certain cases, *e.g.*, hæmatein, the change of colour is not instantaneous, but occupies a finite time. Ostwald's explanation may, however, hold good in the case of certain indicators, such as Tropæolin 000, which show colour-changes in presence of large excess of acid. It is pointed out that in the purest water the concentration of the ionised hydrogen is about 10^{-7} N, and that this concentration represents neutrality. A table is given showing the concentration of $\overset{+}{H}$, at which the change of colour occurs in the case of several indicators. In the case of phenol phthalein the change occurs at a smaller concentration, *i.e.*, in slightly alkaline solution, in the case of methyl orange at higher concentrations of $\overset{+}{H}$, *i.e.*, in distinctly acid solutions. Alizarin and rosolic acid change colour in strictly neutral solutions. By a converse process the different indicators may be used to determine the concentration of the ionised hydrogen in the solution. In carrying out a titration an indicator should be chosen which changes colour at a concentration of hydrogen ions equal to that which exists in a solution of the salt which is to be produced. T. M. L.

1963. *Electrode Potentials in Liquid Ammonia.* **F. M. G. Johnson** and **N. T. M. Wilsmore.** (Faraday Soc., Trans. 8. pp. 70–78; Discussion, pp. 78–80, July, 1907.)—In order to determine the free energy of formation of a series of metallic salts, and also to compare the relative affinities of the corresponding metallic elements under conditions differing as much as possible from those obtaining in the case of measurements in aqueous solutions, the authors have carried out measurements of electrode potentials in liquid ammonia. The metals were K, Na, Ca, Mg, NH_4, Zn, Cd, Ni, Pb, Cu, Hg, and Ag, and their potentials against solutions of their salts of known strength were measured against a standard electrode (Cd in a saturated solution of cadmium nitrate). In order to obtain values for the single electrode potentials, the standard electrode employed was measured directly against the N/10 calomel electrode, but the values (a list of them is given) are very uncertain, owing to the unknown and probably large contact potentials between the different solutions. The order of the potential series is practically the same in liquid ammonia as in water. T. S. P.

1964. *Potential of Hydrogen liberated from Metallic Surfaces.* **H. Nutton** and **H. D. Law.** (Faraday Soc., Trans. 8. pp. 50–68; Discussion, pp. 68–69, July, 1907.)—The object of the experiments described in this paper was the investigation of the chemical reducing power of hydrogen when liberated from the surface of various metallic electrodes, and also of the retarding action caused by the presence of small quantities of metallic salts. The metals used were Cu, polished and platinised Pt, Ni, Sn, Mg, Fe, Al, Zn, Cd, Pb, Hg, and amalgamated Pb and Zn. The electrolytes were either 5 per cent. KOH or 5 per cent H_2SO_4, with or without the addition of 50 per cent. alcohol. The substance to be reduced was benzaldehyde. Measurements of kathode potentials were made in order to differentiate, if possible, between purely chemical changes and those which were due to physical causes, and gave the following results: The supertension of one and the same metal is by no means a fixed quantity; it is influenced by the physical and chemical nature of the surface between wide limits. Film formation also has a large influence. Chemical reactions, such as the formation of resins, are greatly increased by raising the supertension, but these complex bodies may totally mask any other chemical reactions. The nature of the electrolyte can completely change the chemical reaction without any corresponding change in the supertension. The supertension gives small indication of catalytic action, and the fall of potential on adding a depolariser is only a rough guide to the nature of the reduction taking place. The small drop in the e.m.f. in the case of Cu and platinised Pt may be an indication of catalysis. Temperature also has a marked effect, which is not indicated by the e.m.f., on the chemical reactions. Throughout the whole of the investigation the formation of resistance films on the surface of the kathodes was noticed. They were present in the same marked degree with smooth Pt, Hg, and Mg, and were absent only in the cases of roughened Ni, Pt, Cu, and Pb. T. S. P.

1965. *Determination of Diffusion Potentials.* **E. Cohen** and **W. Tombrock.** (Zeitschr. Elektrochem. 13. pp. 612–613, Sept. 6, 1907. Van't Hoff Laborat., Utrecht, June, 1907.)—In connection with the thermodynamics of the Daniell cell, the authors were confronted with the difficulty that the diffusion potential between two differently concentrated solutions of the same electrolyte is not readily determined. They show that if the two cells—

$$\text{Zn} \mid \text{ZnSO}_4 \text{ sol. (1)} \mid \text{ZnSO}_4 \text{ sol. (2)} \mid \text{Zn},$$

and—

$$\text{SO}_4 \mid \text{ZnSO}_4 \text{ sol. (1)} \mid \text{ZnSO}_4 \text{ sol. (2)} \mid \text{SO}_4,$$

are connected in series, the e.m.f. of the combination is twice the diffusion potential required. The electrodes in the first cell consist of 10 per cent. zinc amalgam, and in the second of mercury covered with mercurous sulphate. T. S. P.

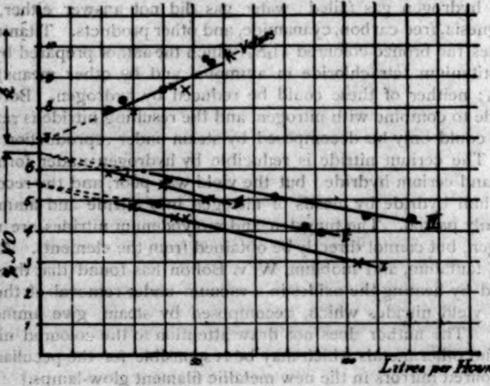
1966. *Action of Depolarisers.* **F. Weigert.** (Zeitschr. Phys. Chem. 60. pp. 513–552, Oct. 1, 1907.)—Using an apparatus similar in principle to that of Nernst and Merriam [see Abstract No. 2301 (1905)], the author has studied the action of a number of kathodic and anodic depolarisers. In nearly all cases the curve showing the relation between the current and the e.m.f. contained a horizontal portion—the limiting current—which was independent of the potential, this being in accordance with Nernst's theory. According as the depolarisation potential, *i.e.*, the potential at which the depolarisation goes on smoothly, is near to or some distance from the potential of the depolariser on open circuit, it is possible to distinguish between quickly and slowly acting depolarisers. Using electrodes of platinised Pt, the following react practically infinitely quickly, the potential on open circuit and depolarisation potentials coinciding: the oxidisers Cl_2, Br_2, and I_2; the reducing agents H_2, I-ions, and I_2 on oxidation to IO_3-ions. The oxidising agents MnO_4-ion, IO_3-ion, BrO_3-ion, O_3 and H_2O_2 act quickly, as also does H_2O_2 as a reducing agent; Cr_2O_7-ion and persulphuric acid act slowly. Any anomalous behaviour of the electrodes was due, in most cases, to the previous treatment they had undergone, *e.g.*, in all cases where the limiting current was not attained, a higher residual current was obtained when the electrode had been previously polarised as kathode than when it had been treated as anode. It is probable that the catalytic properties of Pt are weaker after anodic than after kathodic polarisation. When the limiting current was reached the effects were the same, except for the kathodic depolarisers BrO_3', S_2O_8'', O_3, and H_2O_2; in these cases an intermediate unstable compound is probably formed. The diffusion coefficients at room temperature of chromic, iodic, bromic, and persulphuric acids, and of hydrogen peroxide were determined. With high anode potentials, anomalies in the current-potential curves were observed in the oxidation of H_2O_2, of I to iodic acid, and in the change from ferrous to ferric ions;

this was probably due to the decrease in the catalytic properties of the electrode surface as the anodic polarisation increased. When the reaction velocity at the surface of the electrode is small, *e.g.*, in the reduction of BrO_3'-ions on smooth Pt, it may happen that the current strength is less with a rotating electrode than with a stationary one. This can be explained by the formation of intermediate products, which are further reduced, with infinite velocity, to the final products. [See Abstracts Nos. 1228 (1904), 1118 (1905), 1949 (1906), and 768 (1907).] T. S. P.

1967. *Fixation of Nitrogen; Nitrides, and Ammonia.* **N. Whitehouse.** (Soc. Chem. Ind., Journ. 26. pp. 788–789, July 15, 1907. Electrochem. Ind., N.Y. 5. pp. 361–363, Sept., 1907.)—Many metals bind nitrogen at higher temperatures to nitrides, but the author's attempts to prepare ammonia by the decomposition of the nitride do not promise technical success. Magnesium binds nitrogen readily to Mg_3N_2, which with 6HOH gives $2NH_3$ and $3Mg(OH)_2$, a by-product of little value. Attempts to reduce the nitride by means of hydrogen gas failed; water gas did not answer either, yielding some magnesia, free carbon, cyanamide, and other products. Titanium forms two nitrides, the bronze-coloured Ti_3N_4 (which the author prepared by igniting ammonia-titanium tetrachloride in ammonia and by other means) and the blue TiN_2; neither of these could be reduced by hydrogen. Boron is not easily made to combine with nitrogen, and the resulting nitride is remarkably stable; it could only be decomposed by steam under reproduction of boron trioxide. The cerium nitride is reducible by hydrogen under formation of ammonia and cerium hydride; but the yield was poor, and the reconversion of the cerium hydride by means of nitrogen into nitride and ammonia was likewise only partial. The tungsten and molybdenum nitrides are reducible by hydrogen, but cannot directly be obtained from the elements. As regards vanadium, tantalum, and niobium, W. v. Bolton has found that these metals —prepared by heating the oxides in a vacuum under removal of the oxygen liberated—yield nitrides which, decomposed by steam, give ammonia and the oxide. [The author does not draw attention to the coloured nitrides of titanium and other metals which may be responsible for the peculiar deposition of coloured mirrors in the new metallic filament glow-lamps.] H. B.

1968. *Combustion of Nitrogen in Arcs between Conductors of the Second Class.* **E. Rasch.** (Zeitschr. Elektrochem. 13. pp. 669–674, Oct. 11, 1907.)—In referring to the author's researches, Le Blanc [see Abstract No. 1428 (1907)] had spoken of metallic electrodes, while the author started with electrodes of oxides, which he had wished to use for electric arc lamps. He found, however [see Abstract No. 1222 (1901)], that nitrous vapours were produced in such arcs. According to J. K. Clement, ozone is not formed at the same time, nor do Nernst lamps produce any ozone. The yield of NO is, however, best when the air is passed through the arc at such a rate that a highly diluted NO results. As now the formation of NO from N and O is endothermic, while the further oxidation and combination of NO with water to HNO_3 is exothermic, the author prepares the latter directly. A tubular electrode of rare earth (simply a clay pipe) contains the metallic conductor, a coiled wire of iron or nickel, and is dipped into water; the other electrode consists of a carbon. The air passes in through the tubular electrode. Alternating or continuous currents produce nitric acid, and the water hardly becomes hot, though the end of the pipe may be incandescent. The reaction further yields some other uncondensable white vapours. [These have been observed by Warburg and others.] When the electrode is raised out of the water an arc is observed which is essentially a flame of electrolytic gas. The author tried various absorbents in the place of water, but did not continue the experiments. References are made to Nernst. H. B.

1969. *Validity of the Law of Mass Action for the Combustion of Nitrogen in the High-tension Flame-arc.* **A. Grau** and **F. Russ.** (Zeitschr. Elektrochem. 13. pp. 573–578, Aug. 23, 1907. Technolog. Gewerbe Museum, Wien, June, 1907.) —The authors have published this preliminary note upon their latest experiments in order to correct a misunderstanding by Le Blanc [Abstract No. 1428 (1907)] of their earlier work upon this subject. The more important experimental results of this latest research are shown graphically in the Fig., and from the curves there given the following deductions are made. 1. *Equilibrium of NO-concentration.*—The percentages of NO in the escaping gases were determined for different speeds of the gas current through the apparatus, and the results plotted in curves I., II., III., IV., representing different consumptions of electrical energy in the flame-arc. The curves so obtained were then extended backwards to the zero line. From these curves one can then obtain the NO-concentration corresponding to the equilibrium of the gases for all speeds of the gas current, and it is to be noticed that the curves tend to unite at a concentration of 5·5 per cent. NO for air (curves I. and II.) and at a concentration of 6·6 per cent. NO for a mixture of oxygen and nitrogen in half-molecular proportions (curves III. and IV.). These curves, therefore, prove that the equilibrium point of NO-concentration of the escaping gas is independent of the energy consumption in the flame-arc. II. *Validity of the Law of Mass Action.*—The upper curve in the Fig. shows the value for k obtained in the author's more recent experiments, k being the ratio $(N_2)^{\frac{1}{2}}(O_2)^{\frac{1}{2}}/NO$. The values used for plotting this curve are confined to those obtained with approximately equal energy consumptions and equal speeds of the gas current through the apparatus, it having been shown by the authors in the introduction to this paper that these conditions are essential to correct deductions from the comparison. With higher gas speeds there is greater amount of heat carried away with the exit gases, and the higher energy con-



sumption is partly attributable to this cause. Taking now the values for *k* obtained in the series of experiments I. and III. for a speed up to 55·8 litres of gas per hour, the curve shown in the Fig. which cuts the *y* line of the diagram at 6·9 is obtained. This curve proves that the law of mass action is valid for the combustion of nitrogen in the flame arc. III. *Temperature of the High-tension Flame-arc.*—Calculations based upon Nernst's measurements and the equilibrium concentration values of 5·5 per cent. NO for air and 6·6 per cent. NO for the half-molecular mixture of O and N, show that the temperature attained must be about 3,500° C. [See also Abstracts Nos. 1251, 1429 (1907).] J. B. C. K.

1970. *Nitrogen-Lime.* II. **G. Bredig, W. Fraenkel, and E. Wilke.** (Zeitschr. Elektrochem. 13. pp. 605–612, Sept. 6, 1907. Chem. Universitätslaborat., Heidelberg, Aug., 1907.)—Nitrogen-lime, calcium cyanamide, is formed by heating calcium carbide in nitrogen. The fixation of the nitrogen is much facilitated by the addition of certain salts to the carbide. In continuing their researches [see Abstract No. 780 (1907)] the authors find that the chlorides are far more effective than any other salts, fluorides, oxides, sulphates, phosphates, carbonates, and that for a group of metals the activity decreases with increasing atomic weights in the order Li, Na, K and Be, Mg, Ca, Sr, Ba. The metals themselves, Ca, Mg, Na, had little influence; the influence of the oxides and moisture is unimportant. The authors differ in several respects from Rudolfi [Abstract No. 1741 (1907)], whose temperatures are too low because his thermo-couple was not really embedded in the mass. Their own former temperature estimates were too low, and 815° C. should be substituted for the 800° C. at which the previous experiments were supposed to have been conducted. From determinations of the rate at which the nitrogen gas pressure diminishes when the fixation of nitrogen proceeds at constant volume, the authors conclude that the velocity of the reaction is proportional to the instantaneous pressure of the nitrogen. As regards the cause of the effect of the additions to CaC_2, they consider that it is finally a question of liquefaction. But the melting-point of the addition is not decisive; the behaviour of the whole mixture and the solubility of the carbide in the mixture have to be studied. Thus a mixture of LiCl and KCl proved less efficient than LiCl alone, although the former melts 150° below the latter. H. B.

1971. *Electrolytic Decomposition of Dicarboxylic Organic Acids. Suberic Acid.* **B. L. Vanzetti.** (Accad. Lincei, Atti, 16. pp. 79–84, July 7, and pp. 139–144, July 21, 1907.)—Electrolysis of a 28·8 per cent. aqueous solution of dipotassium suberate, at about 45° C., using platinum electrodes and a current of 0·5 amp. at 12 volts, yields an oily liquid consisting chiefly of unsaturated oxidation products, among which are an alcohol containing 6 carbon atoms and an acid with 7 carbon atoms. A considerable amount of CO_2 is evolved, together with a little oxygen, and about 1 per cent. of CO. No hydrocarbon, saturated or unsaturated, could be detected. W. H. St.

1972. *Electrolytic Estimation of Mercury.* **V. Borelli.** (Gazzetta Chim. Ital. 37. 1. pp. 425–429, 1907.)—None of the text-books dealing with the electrolytic estimation of mercury describe a trustworthy method of drying the mercury deposit before weighing. Heating, even at a low temperature, leads to an appreciable loss of mercury, as also does drying over sulphuric acid, which absorbs mercury vapour. These difficulties are avoided by drying the deposit in a desiccator containing fused potassium hydroxide, four or five hours' drying being sufficient to bring the weight of the deposit to a constant value, which does not change after a further seventy hours. Any very slight loss which may occur in this method may be rendered negligible by placing a small dish of mercury in the desiccator. The nitric acid used to remove the mercury from the platinum capsule on which it is deposited always contains a small quantity of platinum, which has evidently amalgamated with the mercury. T. H. P.

1973. *Electrolytic Deposition of Zinc, using Rotating Electrodes.* II. **T. S. Price.** (Faraday Soc., Trans. 3. pp. 88–97, July, 1907.)—Further experiments on the electrolytic deposition of zinc [Abstract No. 857 (1907)], using as electrolyte ammonium sulphate and ammonia, caustic soda, sodium acetate and acetic acid, ammonium acetate, sodium sulphate alone, and sodium sulphate and sodium acetate, show that the most accurate results are obtained by adding to the solution 2 gm. of sodium sulphate and 1 gm. sodium acetate for each gm. zinc sulphate. The uniformly low results yielded by Kollock and Smith's method [Abstract No. 466 (1906)], are attributed to loss of Hg and Zn during the washing of the amalgam. In using a tap funnel for running off the amalgam, it is advisable to first pour in a little water, which prevents splashing of the mercury when the latter is run in. This water should be pipetted out before the zinc sulphate solution is added.

W. H. Sr.

1974. *Electrolysis of Silver Nitrate.* **A. Leduc** and **Labrouste.** (Comptes Rendus, 145. pp. 55–58, July 1, 1907.)—If with a moderate voltage a moderately concentrated solution of silver nitrate is electrolysed, nothing but silver appears at the kathode. But the deposit is more or less white and compact according to the current density, the concentration, the acidity, and the temperature. The author describes some elaborate tests made to discover any secondary reaction at the kathode, such as is indicated by a variation in the deposit amounting to some hundredths per cent. He finds this reaction to consist in the production of an oxide which dissolves in water like an alkali, producing a compound of the probable formula AgHO. This modified silver the author terms "alkaline silver." No such silver is deposited on mercury electrodes.

E. E. F.

1975. *Influence of Temperature on the Electrolytic Deposition of Metals.* **F. Foerster.** [Experiments by **F. Blankenberg, A. Brunner, H. Lee,** and **W. Römmler.**] (Zeitschr. Elektrochem. 13. pp. 561–567; Discussion, p. 567, Aug. 16, 1907. Paper read before the 14th Hauptversamml. d. Deutsch. Bunsen-Gesell, Hamburg, May 12, 1907.)—Higher temperature does not merely facilitate diffusion. As a rule the kathode potentials, at which metals are deposited, increase only very little with increasing current density, and the curves, potentials as abscissæ, densities as ordinates, are almost perpendicular lines. This does not apply to all complex cyanide solutions, however, and the point is, according to Le Blanc, whether the formation of the complex ion at the soluble anode takes a measurable time (Cu, Zn), or is practically instantaneous (Ag, Cd). The latter two give steep curves; the former slowly rising curves. But at higher temperatures (75 and 90° C.) Cu also gives a steep curve, *i.e.*, the deposition takes place at lower potential, and it is for this reason that Cu and Cd can be separated at the ordinary temperature (Freudenberg), but not at higher temperatures. The ammoniacal solutions of Ni, Cu, Zn behave differently; the deposition potentials of Zn and Ni differ sufficiently from one another, or, as the author expresses it, the velocities of reaction are sufficiently different at higher temperatures to allow of their quantitative separation at 90° (Hollard and Bertiaux), not at ordinary temperature. Finally, the yield of the deposition of Fe and Ni improves with higher temperatures, and the Fe contains less hydrogen. In the *discussion*, **Nernst** called attention to the similar researches of Caspari (1899) and Krüger (1903). H. B.

1976. *The Nature of Supertension [Ueberspannung]. I. Its Thermal Effect.* **F. Kauffer.** (Zeitschr. Elektrochem. 13. pp. 633–637, Sept. 20, 1907.)—Jahn had already shown that an electrode at which "Ueberspannung" exists becomes hotter than an electrode which works reversibly. The author adduces further experiments in proof of this contention. Of two otherwise equal electrolytic troughs coupled in series, the one contains a lead electrode, the other a platinised Pt kathode; both troughs are filled with sulphuric acid and may be regarded as calorimeters. The acid in the Pb cell, which shows the higher potential, becomes warmer than the acid in the Pt cell. Further, benzophenone and acetophenone can be reduced by Pb kathodes, but not by cold Pt kathodes; the reduction succeeds, however, when the Pt kathode is electrically heated. A similar relation holds for the oxidation of *p*-nitrotoluene. There might yet be a supertension at the hot Pt electrode; but the author finds that, for equal current densities, the hot Pt gives a lower potential than the cold Pt. The "Ueberspannung" is therefore due to local heating, and the chemical effects are produced by an increase in the velocity of reaction; there is no need to assume that the pressures of hydrogen and oxygen at electrodes under supertension rise to several thousand atmos. H. B.

1977. *Application of the Electron Theory to Electrolysis.* **E. E. Fournier d'Albe.** (Faraday Soc., Trans. 3. pp. 1–4; Discussion, pp. 4–11, July, 1907. Electrician, 58. pp. 587–588; Discussion, pp. 588–589, Jan. 18, 1907. Chem. News, 95. pp. 28–30, Jan. 18; and Discussion, pp. 57–58, Feb. 1, 1907. Abstract.)—The author describes the electron theory as an extension of the ionic theory of electrochemistry to solids, gases, and a vacuum. Free electrons are possible in metals. In insulating solids or liquids the electrons are effectively bound up with atoms or molecular groups which are arranged in some structure precluding the formation of mobile charged groups and the liberation of ions. In electrolytes such charged groups are formed, sufficiently mobile to follow the e.m.f. But free electrons are not produced by the electrolysis, *e.g.*, of HCl, because the H loses an electron more easily than the Cl; the Cl therefore takes one of the H electrons with it, and the H remains positively and the Cl negatively charged. Attention is drawn to condensation phenomena. When a charged drop evaporates, its electric charge remains and its potential increases as its diameter decreases. More energy is required to evaporate a charged drop than an uncharged drop; condensation on a drop involves an expenditure of available electric energy, and thus condensation is facilitated. This fact explains the low mobility of the ions—whose different mobilities are due to different degrees of hydration—the drop of potential at the electrode, and the liberation of uncharged products at the electrodes. Quantitative determinations of hydration are wanted; isomeric and metameric ions have the same mobility, but ions of the higher valencies exhibit mobilities which are neither independent nor constant for different concentrations (Kohlrausch and Grüneisen). The future of electrolytic theory will lie in the direction of statistical analysis on kinetic principles. In the *discussion*, **N. T. M. Wilsmore** explained how electrolytic reactions are represented on the electron theory; the ferrous ion becomes a ferric ion by giving up a negative electron—which he would call "negatron"—to the "reduction" electrode, while permanganate and dilute acid take negatrons from the "oxidation" electrode under formation of manganous salt and water. H. B.

1978. *Anodic and Kathodic Behaviour of Iron Mirrors and the Passivity of Iron.* **W. J. Müller** and **J. Königsberger.** (Zeitschr. Elektrochem. 13. pp. 659–663, Oct. 4, 1907.)—In continuation of experiments which were recorded in a previous paper [see Abstract No. 2588 (1904)], the authors find that the reflective power of iron mirrors is the same whether they be polarised anodically to 0 volt with marked evolution of oxygen, kathodically to 2·5 volts with evolution of hydrogen, or remain unpolarised, no current passing. The electrolytes used were strongly alkaline, it being immaterial whether SO_4'', HPO_4 or CO_3'', $K^{\cdot}$ or $Na^{\cdot}$ were present together in solution. The polarisation potentials show that in the experiments the iron was either in the passive or active condition, and since the reflective power was the same, it follows that the passive state cannot be due to the presence of a layer of oxide on the iron. Only when a neutral solution of sodium phosphate was used was there an increase in the reflective power, but this was probably due to the formation of a compound of sodium and iron. In the last part of the paper the authors reply to the objections raised to their results by Haber and Goldschmidt, Müller and Spitzer, Gordon and Clark, and Ruer. T. S. P.

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1979. *The Unit-Stere Theory: Relation between the Volumes of the Atoms in Compounds and that of Combined Hydrogen.* **G. Le Bas.** (Phil. Mag. 14. pp. 324–350, Sept., 1907.)

1980. *Production of Steel from Pig Iron containing Chromium, Nickel, and Cobalt.* **A. W. Richards.** (Iron and Steel Inst., Journ. 73. pp. 114–120; Discussion, pp. 121–125, 1907. Engineering. 83. p. 791, June 14, 1907. Metallurgie, 4. pp. 341–345 and 345–348, June 8, 1907.)

1981. *Oxidation of Nitrogen and Conversion of Oxygen into Ozone at High Temperatures.* **F. Fischer** and **F. Braehmar.** (Ber. Deut. Chem. Gesell. 39. pp. 940–968, 1906.)—The authors claim to have succeeded both in detecting ozone produced from oxygen at high temperatures and in isolating it. The principle employed is the sudden cooling of the ozone at the moment of formation by liquid air or oxygen. [See also Abstract No. 2129 (1905).] L. H. W.

1982. *Viscosity Measurements at High Temperatures.* **K. Arndt.** (Zeitschr. Elektrochem. 13. pp. 578–582, Aug. 23, 1907. Elektrochem. Laborat. d. kgl. Techn. Hochschule, Charlottenburg, July 12, 1907.)—The author has measured the viscosity of molten sodium metaphosphate, of boric acid anhydride, and of mixtures of these two substances, by determining the time taken for a platinum weight to fall a given distance through the melt, it being arranged that the velocity of fall was constant during each determination. The temperature varied from 650° to 1,100°. The results are shown in tables and curves, but no remarks are made with respect to them. T. S. P.